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The Metabolic and Hematologic Effects of the Chronic Administration of ACTH to Young and Old Men

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THE lowered resistance of aged persons to nonspecific stress has suggested the possibility that adrenocortical function may be impaired in the normal aged. In a previous study elderly subjects showed probable impairment of activation of the pituitary and thus secondarily of the adrenal when a single dose of epinephrine was used as a stimulant and eosinopenia as a response index. On the other hand, adrenal responsiveness when directly tested by a single injection of adrenocorticotrophic hormone was similar with respect to eosinopenia in young and elderly subjects (28). The present study was designed to supplement this previous study by measuring the magnitude and duration of metabolic and hematologic responses of young and elderly men to the chronic administration of ACTH. This study also supplements the existing data on the responses of healthy individuals to ACTH.

MATERIALS AND METHODS

Subjects.—Two young and 4 elderly subjects were selected on the basis of extensive laboratory and clinical observations. The results of laboratory tests made in all the subjects are summarized in table 1. Additional tests and observations made in certain of the subjects are presented and discussed in the following protocols.

R. K. was a 31 year old negro who had been admitted for domiciliary care because of temporary unemployment. A childhood illness, presumably poliomyelitis, had resulted in atrophy of many muscle groups in the lower extremities. His general health had otherwise been very good.

He appeared to be in excellent health except for partial atrophy of the muscles of the lower extremities. He was able to walk without support and was normally active.

This subject was essentially normal except for the somewhat low renal function which remains unexplained since there was no history of renal disease, and urinalysis and pyelograms were normal.

B. R. was a 32 year old white man admitted because of balanitis due to a beta hemolytic streptococcus. This infection cleared promptly during treatment with sulfadiazine. General health had been very good. A penile lesion in 1946 had been treated with penicillin. Review of organ systems was otherwise essentially negative. No abnormalities were found on physical examination. Serologic test for syphilis was negative.

W. M. was a 65 year old white man under domiciliary care. General health had been excellent. Review of organ systems was negative except for nocturia three times per night. He appeared to be in good health. The anterior-posterior diameter of the chest was increased and the lung fields were hyperresonant. The peripheral arteries were slightly thickened and the retinal arterioles showed slight narrowing. Physical examination was otherwise not remarkable.

Serologic test for syphilis was positive with a reagin titer of 1 unit. Serologic studies of the spinal fluid were negative. Corrected sedimentation rate was 25 mm. per hour. The cause of this elevation was not apparent. Teleoroentgenogram and fluoroscopy of the chest showed normal cardiac size and configuration. There were several thin plaques of calcified material over the apex and portions of the left ventricular border. Ventricular pulsations were

TABLE 1. DATA ON SUBJECTS.

	R. K.	B. R.	W. M.	W. R.	H. C.	J. M.
Age in Years	31	32	65	63	64	72
Race	negro	white	white	white	white	white
Height cm.	163	161	161	166	168	161
Surface Area sq. m.	1.77	1.55	1.60	1.68	1.68	1.62
B. M. R. cal./sq. m./hr.	33	39.5	34.7	39.4	30.5	37.0
B. M. R. per cent[1]	−15	+1	−1	+12	−14	+6
Hematocrit per cent	40	44	41	46	40	41
Corrected Sed. Rate mm./hr.	11	10	25	8	34	35
Leukocytes/cu. mm.	3800	6160	5380	6980	6770	8880
Differential	normal	normal	normal	normal	normal	normal
Eosinophils/cu. mm.	86	112	154	184	56	202
Albuminuria	negative	negative	negative	negative	negative	negative
Urinary Sediment[2] WBC/HPF	3	2	4	2	rare	none
G. F. R.[3] cc./1.73 sq. m./min.	85	129	76	78	80	86
R. P. F.[3] cc./1.73 sq. m./min.	397	896	418	—	—	—
Tm_G[3] mg./1.73 sq. m./min.	260	386	167	231	248	263
Blood Pressure mm. Hg.	120/70	96/56	120/70	94/58	134/64	102/42
Teleoroentgenogram	normal	normal	see text	normal	normal	normal
Electrocardiogram	normal	normal	normal	normal	normal	see text
Vital Capacity	4000	3300	3100	2200	4200	2100
Intravenous Glucose Tolerance	normal	normal	normal	normal	normal	normal
Serologic test for Syphilis	negative	negative	positive	negative	negative	negative
Bromsulfalein Retention[4] per cent	3	—	2	2	2	2
Thymol Turbidity and Cephalin Flocculation	normal	normal	normal	normal	normal	normal
Serum Bilirubin mg./100 cc.	1.0	1.0	1.2	1.0	1.0	1.0
Serum Alkaline Phosphatase Bodansky Units	3.8	—	2.2	2.2	3.0	4.5
Serum Acid Phosphatase Bodansky Units	0	—	0	0	0.4	0.2
Roentgenogram of Spine and Pelvis	normal	normal	normal	hypertrophic arthritis	hypertrophic arthritis	hypertrophic arthritis
Stool Blood	none	none	none	none	none	none
Stool Parasites	none	none	none	none	none	none

[1] Per cent deviation from the normal for the subject's age was calculated from the standards of Boothby and Sandiford (2).

[2] Four or more casual specimens from each patient were examined. None of the patients had erythrocytes or casts in the urinary sediment.

[3] Glomerular filtration rate, effective renal plasma flow, and maximal tubular reabsorption of glucose were done by standard methods (4, 9).

[4] Five mg. per kilogram given. Retention at 45 minutes determined.

normal. Electrocardiogram was normal. There was no evidence of active pericardial or myocardial disease. Venous pressure was 75 mm. of water.

W. R. was a 63 year old white man under domiciliary care. General health had been excellent. There was a history of moderate periodic alcoholism from 50 to 59 years of age. Review of organ systems was negative except for nocturia once a night. He regularly performed a full day's work as ward helper prior to the present study. He was a vigorous man apparently in excellent health. The skin retained a faint residual tan from intensive sun bathing the previous summer. There was no buccal or other pigmentation suggestive of Addison's disease. The peripheral vessels were not palpably sclerotic and retinal vessels were normal. The prostate was one

and one-half times normal size. Physical examination was otherwise not remarkable.

Since the responses of this subject to ACTH were found to be rather weak, additional tests were made one month after completion of the study. Twenty-five mg. of ACTH produced a 54 per cent fall in eosinophils, a 20 per cent rise in urinary uric acid/creatinine ratio, and a 121 per cent rise in potassium/creatinine ratio. This is a normal response for the subject's age group (28). The first part of the Robinson-Kepler-Power water test gave an abnormal result and the second part yielded an A value of 7.6, which is in the range in which Addison's disease cannot be ruled out. Provocative administration of 10 units of crystalline insulin three times a day before meals produced no symptoms.

In a Cutler-Power-Wilder salt-depletion test, the subject showed no change in blood pressure, clinical condition, or serum sodium and chloride, and he excreted urine of normally low concentration of sodium (19 mg. per cent) and chloride (83 mg. per cent) on the third morning of the test. Visual fields and roentgenogram of the sella turcica were normal. On the low calcium diet of the study, the urinary calcium excretion of the subject was rather low (18-20 mg. per day). A relatively low urinary calcium excretion persisted on the high calcium diet given subsequent to the study (approximately 1.5 gm. Ca/day). The urinary calcium was not increased by the administration of 10,000 U. S. P. units of vitamin D per day for two months. Fecal neutral fat, fatty acids, and soap were normal. Serum calcium levels in this patient were within normal limits on all occasions tested and no clinical evidence of heightened muscular irritability was observed.

H. C. was a 64 year old white man under domiciliary care. General health had been good. He had had minimal ankle edema during the summer fifteen months prior to this study. There had been no symptoms of cardiac failure, and he did not have varicose veins. Review of organ systems was essentially negative except for slight chronic postnasal drip, a mild chronic cough productive of small amounts of mucopurulent sputum, and nocturia one to three times per night. He appeared to be in excellent health. Moderate retinal arterial narrowing was present, but the peripheral arteries were soft. No sinus tenderness was present. The prostate was two times enlarged but not indurated. The remainder of the physical examination was normal.

Corrected sedimentation rate was 34 mm. per hour. No cause for this other than the chronic respiratory infection was apparent. Venous pressure was 70 mm. of water. Roentgenograms of the sinuses were interpreted as showing thickening of the lining membranes of the maxillary sinuses. Culture of the postnasal discharge showed pneumococci. Roentgenograms of spine and pelvis showed hypertrophic arthritis. The x-ray appearance of the sella turcica was normal. There was a 51 per cent fall in the concentration of circulating eosinophils after the subcutaneous injection of 0.3 mg. of epinephrine and a 73 per cent fall 4 hours after the intramuscular injection of 25 mg. of ACTH.

J. M. was a 72 year old white man under domiciliary care. He had noticed slight dyspnea on exertion for thirty years. There had been no nocturnal dyspnea or orthopnea. Slight ankle edema after prolonged standing had occurred occasionally in the two years prior to this study. There was no history of precordial pain. Review of systems was otherwise essentially negative except for moderate postnasal drip particularly in the mornings for many years, a mild chronic cough productive of small amounts of mucopurulent sputum, and nocturia two times per night. He appeared well. There was no sinus tenderness. Slight retinal arterial narrowing was present. The anterior-posterior diameter of the chest was increased. The percussion note was hyperresonant, and the breath sounds were distant. The heart sounds were distant, and the first sound over the mitral area was split. There were no murmurs. The prostate was two times normal size but not indurated. The peripheral arteries were slightly thickened. Physical examination was otherwise essentially negative.

Corrected sedimentation rate was 35 mm. per hour. No cause for this other than the chronic respiratory infection was apparent. Electrocardiogram showed low voltage of the QRS complexes and T_1 was low. The P waves were normally prominent. Venous pressure was 60 mm. of water. Roentgenogram showed clouding of the left maxillary sinus. Culture of the postnasal discharge showed alpha streptococci. Roentgenogram showed moderately advanced osteoarthritis of the hip joints. The x-ray appearance of the sella turcica was normal. There was a 30 per cent fall in the concentration of circulating eosinophils after the subcutaneous injection of 0.3 mg. of epinephrine and a 55 per cent fall four hours after the intramuscular injection of 25 mg. of ACTH.

Methods.—The subjects lived on a metabolic ward during the study. Food was prepared in a kitchen used only for this purpose. Aliquots of diet and feces for analysis were obtained by the "wet method" described by Reifenstein, Albright and Wells (26). Dietary, urinary, and fecal nitrogen were done by a macro-Kjeldahl method (13) and plasma protein and nonprotein nitrogen by a micro-Kjeldahl method (13). Plasma albumin was determined by a micro-Kjeldahl method after

precipitation of globulin with sodium sulfate (16). Phosphorus was determined by the method of Fiske and Subbarow (7), calcium according to Fiske and Logan (6), creatinine as described by Peters (21), glucose by the method of Nelson (20), and chloride as described by Peters and Van Slyke (22). Uric acid was done by Archibald's modification of the method of Kern and Stransky as adapted by Forsham and associates (8). Sodium and potassium were determined on a Beckman flame photometer. Normal propyl alcohol was added to the solutions to assure even flow through the atomizer. Sodium determinations were done first, and the potassium standards and solutions for analysis of potassium brought to the same concentration of sodium.

The hematocrit, CO_2 content, and pH of blood were determined by the technique of Shock and Hastings (27). From these data the bicarbonate content of plasma was calculated (12). Eosinophil counts were done by Forsham's modification of the method of Dungar (8). The method of Wintrobe (29) was used in determining sedimentation rate. The 17-ketosteroid and formaldehydogenic steroid determinations were made in Dr. Konrad Dobriner's laboratory at the Sloan-Kettering Institute.

The urine was extracted by a procedure described by Lieberman and Dobriner (19). The 17-ketosteroid values reported are the sum of the 17-ketosteroid values obtained on extracts AE, BE, and CE. This procedure gives consistently higher values for 17-ketosteroid than those usually reported in the literature. Formaldehydogenic steroids were done by a method which is in principle similar to that of Cocoran and Page (3). The formaldehydogenic steroid values reported are the sum of the values obtained on extracts AE, BE, and CE (19).

Procedure.—The 2 young and 4 elderly subjects were studied during a 15 day control period, a 12 day period of administration of 25 mg. (Armour standard LA-l-A equivalent) of Armour ACTH (Lot J 9801)[1] every 6 hours, and an 18 day recovery period. The following measurements were made: metabolic balances of sodium, chloride, potassium, calcium, phosphorus, and nitrogen; the urinary excretion of creatinine, glucose, uric acid, 17-ketosteroids, and formaldehydogenic steroids; the plasma sodium, potassium, phosphorus, calcium, bicarbonate content, pH, protein, albumin, globulin, and nonprotein nitrogen; the blood leukocyte count, differential eosinophil count, hematocrit, and sedimentation rate; and body weight. The daily intakes of N, Na, Cl, K, Ca, and P are indicated in the footnotes of tables 2 to 7.

The diet for R. K., B. R., W. M., and W. R. contained approximately 100 gm. protein, 265 gm. carbohydrate, and 120 gm. of fat; that for H. C. and J. M. 100 gm. protein, 290 gm. of carbohydrate, and 130 gm. of fat. The latter 2 subjects were given a somewhat larger diet because the first 4 who were studied complained rather bitterly of hunger during the administration of ACTH, although not in the control period.

Results

Clinical Observations.—There was slight to moderate increase in the fullness of the facial contours of the elderly subjects in the latter part of the period of administration of ACTH. During this period the facial and cervical skin of W. M., W. R., and H. C. became flushed. There was no definite change in the facial appearance of the young subjects. W. M., J. M., and H. C. developed pretibial edema on ACTH. There was no dependent edema in the other subjects.

B. R., R. K., W. M., and W. R. experienced a sense of increased energy and well-being on ACTH. B. R., whose pre-treatment personality was the most labile, became excessively cheerful and playful. H. C. and J. M. noted little physical or mood change on ACTH. In the recovery period the subjects felt slightly fatigued and B. R. became sullen and argumentative.

Febrile illnesses occurred in 4 of the subjects during the course of the study.

R. K. developed cough and nasal congestion on the

[1] The following assay data were kindly furnished by Dr. Jonn R. Mote of the Armour Laboratories: Vasopressor activity—less than 1 U.S.P. unit, and oxytocic activity—less than 0.1 U.S.P. unit per 25 mg. of ACTH. There was less than 2 per cent each of the following anterior pituitary hormones; gonadotropin, prolactin, growth hormone, and thyrotropin.

tenth day of ACTH. These symptoms continued, and on the third day after withdrawal of ACTH his cough became productive of rusty sputum containing type 9 pneumococci. There was a small area of infiltration in the left lower lung field, and his oral temperature reached 101.6 F. Blood cultures were sterile. No treatment was given, but he became afebrile during that night and subsequently felt and appeared well. The area of infiltration disappeared in four days.

W. R. developed a mild respiratory infection with malaise, cough, and low grade fever on the third day after withdrawal of ACTH. There was no leukocytosis, and roentgenogram of the lung fields was clear. Symptoms subsided in three days. Similar symptoms developed five days later and lasted four days. He was given penicillin in this second episode.

On the second day after the withdrawal of ACTH, H. C. developed fever which did not exceed 101.2 F. rectally and which lasted four days. The mild chronic cough that he had did not change during this period and no new signs or symptoms developed. The leukocytosis he had developed on ACTH returned only slowly to normal. Blood culture was sterile, and sputum culture showed only the organisms previously present. Roentgenogram of the chest was clear.

On the second day after the withdrawal of ACTH, J. M. developed fever which gradually increased reaching 102.2 F. in the course of five days. His cough increased, there were sibilant rales over the left upper lung field, leukocytosis was present, and sputum culture contained pneumococci. Roentgenogram of the lungs was clear, and blood culture was sterile. On the fifth day of fever penicillin was started, and over a period of four days his temperature returned to normal. Penicillin was continued for an additional four days.

Metabolic Studies.—The metabolic data on the subjects are given in tables 2 to 7 and shown graphically in figures 1 to 12. The balance charts in the figures are constructed in the following manner. Intake is plotted down from the zero line, fecal output is plotted up from the intake line, and urinary output is plotted up from fecal output. Thus a hatched area above the zero line represents negative balance, and a clear area below the zero line represents positive balance. Statements made in the text concerning the loss and retention of elements by the body are based on the increase or decrease of the balance in question over the baseline balance of the last nine days of the control period.

During the administration of ACTH there was a gradual increase in weight. In 1 subject weight gain persisted throughout the administration of ACTH. In the other subjects the weight peak was reached during the last four days of ACTH and was followed by a gradual decrease in weight. After withdrawal of ACTH there was a rapid loss of weight which exceeded previous weight gain, continued about six days, and was followed by gradual weight gain.

Chloride was retained in most subjects throughout the period of ACTH administration. However, in W. M. chloride was lost during the last three days of ACTH administration and in H. C. chloride retention lasted only three days. Following the withdrawal of ACTH, chloride was rapidly lost in an amount which exceeded the previous retention. Following this large loss of chloride there was a brief compensatory period of retention.

Sodium was retained throughout the ACTH period in R. K., W. R., and J. M. Small losses occurred in the other subjects during the last few days of ACTH administration. Following the withdrawal of ACTH, the quantity of sodium lost exceeded the quantity previously retained in all subjects except H. C., whose retention and subsequent loss were approximately equal. Following these large losses of sodium, there were subsequent compensatory periods of retention.

In each subject the ratio of sodium retention to chloride retention was considerably greater than the ratio of these ions in extracellular fluid.

All the subjects had a potassium diuresis on the first day of ACTH followed by smaller losses throughout the period of administration of ACTH. Following the withdrawal of ACTH potassium was retained. A portion of the loss during the ACTH period can be attributed to the loss of protoplasm. Potassium loss due to protoplasmic breakdown was calculated on the assumption that the ratio of milliequivalents of potassium to grams of nitrogen in the protoplasm catabolized was 2.7 (26). The potassium balances not attributable to protoplasmic loss as measured by nitrogen bal-

TABLE 2. METABOLIC DATA ON SUBJECT R. K.[1,2]

Period	Day	Weight of Patient	Urine Volume	Nitrogen			Sodium			Chloride			Potassium			Calcium			Phosphorus			Urinary Excretion				Serum					Blood Eosinophils
				Urine	Stool	Balance	Urine	Stool	Balance	Urine	Stool	Balance	Urine	Stool	Balance	Urine	Stool	Balance	Urine	Stool	Balance	Uric Acid	Glucose	17-Keto-steroids	Formalde-hydrogenic steroids	Potassium	Bicarbonate Content	pH	Uric Acid	Glucose	
		kg.	cc.	gm.	gm.	gm.	mEq.	mEq.	mEq.	mEq.	mEq.	mEq.	mEq.	mEq.	mEq.	mg.	mg.	mg.	mg.	mg.	mg.	gm.	gm.	mg.	mg.	mEq./L	mEq./L		mg. %	mg. %	cells/cu. mm.
Control	7- 9	72.0	1660	14.1	1.8	−0.5	93	4	− 4	81	3	+ 4	43	18	+ 8	113	208	− 37	972	345	−180	0.85		18	0.2	3.8	26	7.40	5.3	97	97
	10-12	71 9	1630	12.8	1.8	+0.8	77	4	+ 12	74	3	+ 11	41	18	+10	111	208	− 35	867	345	− 75	0.76	1.2	18	0.2						
	13-15	71.5	1307	12.5	1.8	+1.1	71	4	+ 18	69	3	+ 16	39	18	+12	123	208	− 47	802	345	− 10	0.69	1.1	18	0.2	3.7	26	7.36	5.4	90	88
ACTH	16	71.2	1760	16.3	1.8	−2.7	87	1	+ 5	94	2	− 8	78	27	−36	123	215	− 54	1079	527	−469	1.24	1.8	38	8.2						
	17	71.0	1140	16.0	1.8	−2.4	24	1	+ 68	41	2	+ 45	57	27	−15	106	215	− 37	862	527	−252	1.07	2.0	38	8.2						
	18	71.0	1000	16.5	1.8	−2.9	16	1	+ 76	37	2	+ 49	56	27	−14	94	215	− 25	922	527	−312	1.01	1.8	38	8.2						
	19	71.5	1320	17.6	1.8	−4.0	16	1	+ 76	36	2	+ 50	49	27	− 7	96	215	− 27	1219	527	−609	1.18	1.8	46	10.6	3.8	26	7.43	3.9	120	3
	20	71.6	1020	17.6	1.8	−4.0	16	1	+ 76	36	2	+ 50	49	27	− 7	96	215	− 27	1219	527	−609	1.18	1.6	46	10.6						
	21	72.1	1390	17.6	1.8	−4.0	16	1	+ 76	36	2	+ 50	49	27	− 7	96	215	− 27	1219	527	−609	1.18	1.8	46	10.6						
	22	72.0	1400	20.0	1.8	−6.4	33	4	+ 56	46	2	+ 40	50	30	−11	149	188	− 53	994	612	−469	1.12	1.7	48	5.5	3.8	26	7.46	3.9	112	3
	23	72.0	1170	20.0	1.8	−6.4	33	4	+ 56	46	2	+ 40	50	30	−11	149	188	− 53	994	612	−469	1.12	1.8	48	5.5						
	24	72.2	1200	20.0	1.8	−6.4	33	4	+ 56	46	2	+ 40	50	30	−11	149	188	− 53	994	612	−469	1.12	1.6	48	5.5						
	25	72.4	1710	20.2	1.8	−6.6	57	4	+ 32	67	2	+ 19	50	30	−11	155	188	− 59	998	612	−473	1.06	2.3	61	12.4						
	26	72.4	1540	20.2	1.8	−6.6	45	4	+ 44	57	2	+ 29	50	30	−11	155	188	− 59	998	612	−473	1.06	1.8	61	12.4	3.3	29	7.44	3.5	124	0
	27	72.3	1580	20.2	1.8	−6.6	42	4	+ 47	51	2	+ 35	50	30	−11	155	188	− 59	998	612	−473	1.06	1.7	61	12.4						
Recovery	28	72.2	2690	17.8	1.7	−4.1	252	4	−163	177	1	− 90	21	15	+33	262	200	−178	490	454	+193	0.93	1.4	26	0.9	3.6	30	7.46	3.8	120	2
	29	70.8	4050	18.0	1.7	−4.3	535	4	−446	384	1	−297	24	15	+30	288	200	−204	843	454	−160	1.13	1.3	26	0.9						
	30	68.6	2310	15.1	1.7	−1.4	171	4	− 82	98	1	− 11	18	15	+36	94	200	− 10	782	454	− 99	0.94	1.2	26	0.9	3.6	28	7.51	4.0	92	20
	31	68.3	1940	12.9	1.7	+0.8	156	4	− 67	90	1	− 3	14	15	+40	132	200	− 48	876	454	−193	1.03	1.4	14	0.6						
	32	67.3	1140	12.9	1.7	+0.8	95	4	− 6	55	1	+ 32	13	15	+41	80	200	+ 4	641	454	+ 42	0.76	1.1	14	0.6						
	33	67.2	1120	12.9	1.7	+0.8	121	4	− 32	90	1	− 3	26	15	+28	101	200	− 17	639	454	+ 44	0.82		14	0.6						
	34-36	66.6	1457	12.1	2.2	+2.0	60	8	+ 25	65	3	+ 21	56	20	− 6	89	235	− 33	752	465	− 40	0.53		17	0.2	4.5	26	7.45	4.9	88	51
	37-39	66.9	1233	11.4	2.2	+2.7	44	8	+ 41	51	3	+ 35	54	20	− 4	96	235	− 40	755	465	− 43	0.70		20	0.3						
	40-42	67.0	1313	10.9	1.6	+3.5	49	2	+ 45	49	1	+ 40	40	14	+17	116	184	− 40	703	339	+121	0.62		14	0.2	4.2	24	7.41	5.6	94	56
	43-45	68.1	1720	10.6	1.6	+3.9	87	2	+ 7	83	1	+ 6	43	14	+14	119	184	− 43	642	339	+182	0.59	1.2	16	0.2	4.1	26	7.40	5.0	90	67
	46	68.2																													

[1] Daily intakes for days 7–33 were N_2 15.4 gm., Na 93 mEq., Cl 88 mEq., K 69 mEq, Ca 284 mg., and P 1137 mg.; for days 34–39, N_2 16.3 gm., Na 93 mEq., Cl 89 mEq., K 70 mEq., Ca 291 mg., and P 1177 mg.; and for days 40–45 N_2 16.0 gm., Na 96 mEq., Cl 90 mEq., K 71 mEq., Ca 260 mg., and P 1163 mg.

[2] In this and subsequent tables the value given for each 3 day period is the average for those 3 days except in the case of weight. The weight is that at the beginning of the period.

TABLE 3. METABOLIC DATA ON SUBJECT B. R.[1]

Period	Day	Weight of Patient	Urine Volume	Nitrogen			Sodium			Chloride			Potassium			Calcium			Phosphorus			Urinary Excretion				Serum					Blood Eosinophils
				Urine	Stool	Balance	Urine	Stool	Balance	Urine	Stool	Balance	Urine	Stool	Balance	Urine	Stool	Balance	Urine	Stool	Balance	Uric Acid	Glucose	17-Keto-steroids	Formalde-hydogenic steroids	Potassium	Bicarbonate Content	pH	Uric Acid	Glucose	
		kg.	cc.	gm.	gm.	gm.	mEq.	mEq.	mEq.	mEq.	mEq.	mEq.	mEq.	mEq.	mEq.	mg.	mg.	mg.	mg.	mg.	mg.	gm.	gm.	mg.	mg.	mEq./L	mEq./L		mg. %	mg. %	cells/cu. mm.
Control	7- 9	52.9	2047	13.4	1.8	+0.3	99	2	− 8	87	1	0	53	15	+ 7	145	276	−127	910	300	− 56	0.98		22	0.2	4.1	25	7.34	4.8	85	90
	10-12	52.7	1907	12.6	1.8	+1.1	72	2	+ 19	66	1	+21	50	15	+10	138	276	−120	861	300	− 7	0.91	1.6	22	0.2						
	13-15	52.6	1958	12.2	1.8	+1.5	72	2	+ 19	68	1	+19	53	15	+ 7	135	276	−117	805	300	+ 49	0.89	1.9	22	0.2	4.1	24	7.36	4.3	80	117
ACTH	16	52.6	1810	13.8	1.6	+0.1	68	1	+ 24	72	1	+15	90	13	−28	114	203	− 23	854	290	+ 10	1.20	2.3	33	3.5						
	17	52.7	1780	13.3	1.6	+0.6	33	1	+ 59	53	1	+34	66	13	− 4	186	203	− 95	857	290	+ 7	1.13	3.8	33	3.5						
	18	52.8	1120	12.4	1.6	+1.5	39	1	+ 53	50	1	+37	56	13	+ 6	160	203	− 69	685	290	+179	1.04	4.4	33	3.5						
	19	52.8	1470	14.2	1.6	−0.3	37	1	+ 55	56	1	+31	61	13	+ 1	200	203	−109	832	290	+ 32	1.10	3.3	36	6.7	4.2	24	7.38	2.9	98	16
	20	53.2	1430	14.2	1.6	−0.3	37	1	+ 55	56	1	+31	61	13	+ 1	200	203	−109	832	290	+ 32	1.10	4.6	36	6.7						
	21	53.5	1490	14.2	1.6	−0.3	37	1	+ 55	56	1	+31	61	13	+ 1	200	203	−109	832	290	+ 32	1.10	4.1	36	6.7						
	22	53.5	1370	14.8	1.6	−0.9	48	4	+ 41	55	2	+31	60	14	+ 1	181	181	− 68	1032	330	−208	1.14	4.8	42	7.0	3.7	23	7.46	3.0	104	6
	23	53.5	1690	14.8	1.6	−0.9	48	4	+ 41	55	2	+31	60	14	+ 1	181	181	− 68	1032	330	−208	1.14	5.2	42	7.0						
	24	53.6	1260	14.8	1.6	−0.9	48	4	+ 41	55	2	+31	60	14	+ 1	181	181	− 68	1032	330	−208	1.14	5.3	42	7.0						
	25	54.0	1820	17.2	1.6	−3.3	54	4	+ 35	62	2	+24	60	14	+ 1	219	181	−106	1163	330	−339	1.33	5.4	58	8.1						
	26	53.7	1780	17.2	1.6	−3.3	84	4	+ 5	78	2	+ 8	60	14	+ 1	219	181	−106	1163	330	−339	1.33	6.4	58	8.1	3.2	26	7.44	2.6	109	3
	27	53.5	2170	17.2	1.6	−3.3	97	4	− 8	81	2	+ 5	60	14	+ 1	219	181	−106	1163	330	−339	1.33	6.6	58	8.1						
Recovery	28	53.2	2400	16.5	2.0	−3.0	194	4	−105	132	2	−46	21	14	+40	253	244	−203	581	402	+171	1.03	1.8	27	0.7	3.7	27	7.42	2.6	104	2
	29	52.8	2945	14.7	2.0	−1.2	277	4	−188	185	2	−99	16	14	+45	210	244	−160	853	402	−101	1.13	1.4	27	0.7						
	30	51.5	2565	14.0	2.0	−0.5	227	4	−138	154	2	−68	15	14	+46	158	244	−108	1091	402	−339	1.13	1.3	27	0.7	4.0	24	7.41	4.3	87	136
	31	50.8	2400	13.8	2.0	−0.3	156	4	− 67	108	2	−22	27	14	+34	98	244	− 48	985	402	−233	1.03	1.2	18	0.4						
	32	50.1	1810	13.8	2.0	−0.3	112	4	− 23	97	2	−11	47	14	+14	75	244	− 25	982	402	−230	1.06	1.3	18	0.4						
	33	50.0	1820	13.8	2.0	−0.3	94	4	− 5	95	2	− 9	79	14	−18	74	244	− 24	1037	402	−285	1.09		18	0.4						
	34-36	49.9	1633	13.1	2.0	+1.3	42	2	+ 49	48	1	+40	69	14	− 7	70	229	+ 5	987	318	−109	0.97		21	0.2	4.7	25	7.39	4.2	75	101
	37-39	50.3	1710	12.6	2.0	+1.8	73	2	+ 18	71	1	+17	63	14	− 1	110	229	− 35	858	318	+ 20	0.90		25	0.1						
	40-42	50.5	1822	12.0	2.0	+2.1	85	3	+ 8	72	2	+17	54	15	+ 9	120	245	− 92	792	334	+ 56	0.89		23	0.2	4.3	23	7.37	4.0	92	87
	43-45	50.9	1830	11.8	2.0	+2.3	80	3	+ 13	80	2	+ 9	53	15	+10	116	245	− 88	754	334	+ 94	0.88	1.4	21	0.1	4.3	25	7.37	4.0	79	111
	46	50.9																													

[1] Daily intakes for days 7–33 were N_2 15.5 gm., Na 93 mEq., Cl 88 mEq., K 75 mEq., Ca 294 mg., and P 1154 mg.; for days 34–39, N_2 16.4 gm., Na 93 mEq., Cl 89 mEq., K 76 mEq., Ca 304 mg., and P 1196 mg.; and for days 40–45, N_2 16.1 gm., Na 96 mEq., Cl 91 mEq., K 78 mEq., Ca 273 mg., and P 1182 mg.

TABLE 4. METABOLIC DATA ON SUBJECT W. M.[1]

Period	Day	Weight of Patient	Urine Volume	Nitrogen			Sodium			Chloride			Potassium			Calcium			Phosphorus			Urinary Excretion				Serum					Blood Eosinophils
				Urine	Stool	Balance	Urine	Stool	Balance	Urine	Stool	Balance	Urine	Stool	Balance	Urine	Stool	Balance	Urine	Stool	Balance	Uric Acid	Glucose	17-Keto-steroids	Formaldehydogenic steroids	Potassium	Bicarbonate Content	pH	Uric Acid	Glucose	
		kg.	cc.	gm.	gm.	gm.	mEq.	mEq.	mEq.	mEq.	mEq.	mEq.	mEq.	mEq.	mEq.	mg.	mg.	mg.	mg.	mg.	mg.	gm.	gm.	mg.	mg.	mEq. /L	mEq. /L		mg. %	mg. %	cells/ cu. mm.
	7- 9	58.0	1997	12.5	1.3	+1.7	87	1	+ 5	75	1	+12	53	11	+11	114	233	− 53	839	278	+ 37	0.92		15	0.1	4.0			7.2	91	172
Control	10-12	57.6	1761	12.5	1.3	+1.7	78	1	+ 14	71	1	+16	56	11	+ 8	107	233	− 46	862	278	+ 14	0.84	1.1	15	0.1						
	13-15	57.5	1875	12.3	1.3	+1.9	84	1	+ 8	78	1	+ 9	57	11	+ 7	103	233	− 42	799	278	+ 77	0.86	1.0	15	0.1	4.0	22	7.39	6.9	92	119
	16	57.6	1800	14.8	1.4	−0.7	74	1	+ 18	91	1	− 4	95	13	−33	126	217	− 49	817	353	− 16	1.22	1.4	23	3						
	17	57.4	1670	14.4	1.4	−0.3	42	1	+ 50	57	1	+30	61	13	+ 1	149	217	− 72	718	353	+ 83	1.04	2.9	23	3						
	18	57.7	1130	14.2	1.4	−0.1	26	1	+ 66	46	1	+41	61	13	+ 1	112	217	− 35	779	353	+ 22	1.07	1.7	23	3						
	19	58.1	1680	17.3	1.4	−3.2	22	1	+ 70	42	1	+45	67	13	− 5	93	217	− 16	952	353	−151	0.95	4.1	30	10	3.6	26	7.41	4.8	122	3
	20	58.2	1470	17.3	1.4	−3.2	22	1	+ 70	42	1	+45	67	13	− 5	93	217	− 16	952	353	−151	0.95	1.8	30	10						
ACTH	21	58.8	1950	17.3	1.4	−3.2	22	1	+ 70	42	1	+45	67	13	− 5	93	217	− 16	952	353	−151	0.95	2.9	30	10						
	22	58.7	1930	18.3	1.1	−3.9	46	1	+ 46	55	1	+32	71	11	− 7	103	217	− 26	1083	322	−251	1.14	2.3	..	..	3.8	24	7.41	5.1	116	2
	23	58.9	1670	18.3	1.1	−3.9	46	1	+ 46	55	1	+32	71	11	− 7	103	217	− 26	1083	322	−251	1.14	2.0	..	..						
	24	58.8	1100	18.3	1.1	−3.9	46	1	+ 46	55	1	+32	71	11	− 7	103	217	− 26	1083	322	−251	1.14	1.7	..	..						
	25	59.2	1640	19.6	1.1	−5.2	87	1	+ 5	89	1	− 2	84	11	−20	156	217	− 79	1266	322	−434	1.25	3.3	54	14						
	26	59.3	1790	19.6	1.1	−5.2	105	1	− 13	109	1	−22	84	11	−20	156	217	− 79	1266	322	−434	1.25	2.1	54	14	3.2	27	7.45	4.4	117	3
	27	58.7	1940	19.6	1.1	−5.2	110	1	− 18	112	1	−25	84	11	−20	156	217	− 79	1266	322	−434	1.25	2.4	54	14						
	28	58.4	2405	16.1	1.4	−2.0	167	1	− 75	94	1	− 7	26	12	+37	109	276	− 91	603	380	+171	0.90	1.1	26	1.2	3.2	31	7.42	4.4	116	2
	29	57.6	2265	15.0	1.4	−0.9	297	1	−205	179	1	−92	24	12	+39	144	276	−126	958	380	−184	1.09	1.1	26	1.2						
	30	56.9	2620	14.8	1.4	−0.7	274	1	−182	175	1	−88	30	12	+33	149	276	−131	1086	380	−312	1.09	1.4	26	1.2	3.8	24	7.42	5.1	78	128
	31	55.9	2390	13.1	1.4	+1.0	233	1	−141	170	1	−83	46	12	+17	133	276	−115	1020	380	−246	1.04	2.9	16	0.3						
Re-	32	55.3	1550	13.1	1.4	+1.0	123	1	− 31	99	1	−12	63	12	0	105	276	− 87	930	380	−156	0.94	1.4	16	0.3						
covery	33	55.2	1730	13.1	1.4	+1.0	81	1	+ 11	77	1	+10	64	12	− 1	98	276	− 80	839	380	− 65	0.88	1.1	16	0.3						
	34-36	54.9	1553	11.8	1.6	+3.0	50	1	+ 42	56	1	+32	66	13	− 3	107	253	− 56	805	343	+ 48	0.86		14	0.3	4.4	23	7.37	4.6	92	89
	37-39	55.8	1640	11.2	1.6	+3.6	79	1	+ 13	71	1	+17	57	13	+ 6	134	253	− 83	692	343	+161	0.84		15	0.2						
	40-42	56.2	1540	10.6	1.5	+4.1	78	1	+ 14	66	1	+21	48	13	+17	114	250	− 91	519	320	+350	0.70		..	0.2	4.2	24	7.39	5.7	84	103
	43-45	56.4	1540	10.5	1.5	+4.2	89	1	+ 3	84	1	+ 3	52	13	+13	126	250	−103	677	320	+192	0.87	1.1	13	0.3	4.4	25	7.40	5.6	85	113
	46	56.9																													

[1] Daily intakes for days 7–33 were N_2 15.5 gm., Na 93 mEq., Cl 88 mEq., K 75 mEq., Ca 294 mg., and P 1154 mg.; for days 34–39, N_2 16.4 gm., Na 93 mEq., Cl 89 mEq., K 76 mEq., Ca 304 mg., and P 1196 mg.; and for days 40–45, N_2 16.2 gm., Na 93 mEq., Cl 88 mEq., K 78 mEq., Ca 273 mg., and P 1189 mg.

TABLE 5. METABOLIC DATA ON SUBJECT W. R.[1]

Period	Day	Weight of Patient	Urine Volume	Nitrogen			Sodium			Chloride			Potassium			Calcium			Phosphorus			Urinary Excretion				Serum					Blood Eosinophils
				Urine	Stool	Balance	Urine	Stool	Balance	Urine	Stool	Balance	Urine	Stool	Balance	Urine	Stool	Balance	Urine	Stool	Balance	Uric Acid	Glucose	17-Keto-steroids	Formaldehydogenic steroids	Potassium	Bicarbonate Content	pH	Uric Acid	Glucose	
		kg.	cc.	gm.	gm.	gm.	mEq.	mEq.	mEq.	mEq.	mEq.	mEq.	mEq.	mEq.	mEq.	mg.	mg.	mg.	mg.	mg.	mg.	gm.	gm.	mg.	mg.	mEq./L	mEq./L		mg. %	mg. %	cells/cu. mm.
	7- 9	60.2	1660	13.8	1.9	−0.2	89	4	0	81	2	+ 5	54	20	+ 1	18	317	− 41	836	450	−132	0.83		23	0.1	4.6	22	7.36	5.9	90	189
Control	10-12	59.5	1697	13.2	1.9	+0.4	94	4	− 5	83	2	+ 3	54	20	+ 1	18	317	− 41	831	450	−127	0.79	1.2	23	0.1						
	13-15	59.5	1803	13.5	1.9	+0.1	85	4	+ 4	79	2	+ 7	54	20	+ 1	23	317	− 46	759	450	− 55	0.82	1.1	23	0.1	4.4	23	7.35	5.4	89	158
	16	59.4	1570	14.8	1.9	−1.2	78	2	+ 13	85	1	+ 2	82	17	−24	15	398	−119	850	458	−154	0.97	1.2	25	1.3						
	17	59.3	1380	13.6	1.9	0	52	2	+ 39	59	1	+ 28	53	17	+ 5	24	398	−128	755	458	− 59	0.85	1.2	25	1.3						
	18	59.6	1360	13.6	1.9	0	51	2	+ 40	60	1	+ 27	57	17	+ 1	24	398	−128	701	458	− 5	0.94	1.3	25	1.3						
	19	59.9	1400	12.8	1.9	+0.8	47	2	+ 44	56	1	+ 31	54	17	+ 4	32	398	−136	633	458	+ 63	0.88	1.2	28	2.8	3.8	25	7.38	4.4	94	100
	20	60.0	1450	12.8	1.9	+0.8	47	2	+ 44	56	1	+ 31	54	17	+ 4	32	398	−136	633	458	+ 63	0.88	1.4	28	2.8						
ACTH	21	60.2	1360	12.8	1.9	+0.8	47	2	+ 44	56	1	+ 31	54	17	+ 4	32	398	−136	633	458	+ 63	0.88	1.1	28	2.8						
	22	60.3	1280	14.0	1.8	−0.3	36	3	+ 54	54	2	+ 32	64	20	− 9	31	284	− 21	624	476	+ 54	0.96	1.4	25	3.7	4.0	25	7.40	4.2	104	84
	23	60.8	1420	14.0	1.8	−0.3	36	3	+ 54	54	2	+ 32	64	20	− 9	31	284	− 21	624	476	+ 54	0.96	1.3	25	3.7						
	24	60.9	1090	14.0	1.8	−0.3	36	3	+ 54	54	2	+ 32	64	20	− 9	31	284	− 21	624	476	+ 54	0.96	1.3	25	3.7						
	25	61.4	1780	15.3	1.8	−1.6	44	3	+ 46	55	2	+ 31	65	20	−10	46	284	− 36	864	476	−186	1.02	1.3	30	7.1						
	26	61.5	1500	15.3	1.8	−1.6	46	3	+ 44	62	2	+ 24	65	20	−10	46	284	− 36	864	476	−186	1.02	1.2	30	7.1	3.6	28	7.45	3.6	111	117
	27	61.8	1340	15.3	1.8	−1.6	59	3	+ 31	65	2	+ 21	65	20	−10	46	284	− 36	864	476	−186	1.02	1.4	30	7.1						
	28	62.0	1620	13.2	1.4	+0.9	125	4	− 36	86	2	0	25	12	+38	49	233	+ 12	585	379	+190	0.71	1.1	26	1.0	3.6	27	7.41	3.8	100	170
	29	61.7	3035	14.6	1.4	−0.5	323	4	−234	243	2	−157	25	12	+38	72	233	− 11	787	379	− 12	0.95	1.1	26	1.0						
	30	60.6	2695	16.0	1.4	−1.9	353	4	−264	251	2	−165	29	12	+34	41	233	+ 20	865	379	− 90	1.13	1.2	26	1.0	3.9	26	7.43	4.7	85	315
	31	59.2	2283	15.5	1.4	−1.4	176	4	− 87	128	2	− 42	36	12	+27	21	233	+ 40	901	379	−126	0.95	1.2	..	0.3						
Re-	32	58.9	2330	15.5	1.4	−1.4	138	4	− 49	105	2	− 19	60	12	+ 3	13	233	+ 48	888	379	−113	1.08	1.2	..	0.3						
covery	33	58.1	980	15.5	1.4	−1.4	61	4	+ 28	51	2	+ 35	65	12	− 2	10	233	+ 51	886	379	−111	0.84		..	0.3						
	34-36	58.0	1190	13.3	1.9	+1.2	52	4	+ 37	49	1	+ 39	57	18	+ 1	26	357	− 79	861	510	−175	0.66		16	0.1	4.8	23	7.41	4.9	81	200
	37-39	58.1	1280	13.0	1.9	+1.5	134	4	− 45	116	1	− 28	60	18	− 2	23	357	− 76	647	510	+ 39	0.85		18	0.2						
	40-42	57.4	1490	14.2	1.7	+0.2	48	6	+ 42	46	2	+ 43	48	18	+12	31	283	− 41	852	462	−132	0.81		20	0.2	4.7	22	7.39	5.1	89	62
	43-45	57.4	1540	12.0	1.7	+2.4	60	6	+ 30	60	2	+ 29	50	18	+10	18	283	− 28	618	462	+102	0.60		14	0.1	5.1	23	7.41	4.0	83	279
	46	57.3																													

[1] Daily intakes for days 7–33 were N_2 15.5 gm., Na 93 mEq., Cl 88 mEq., K 75 mEq., Ca 294 mg., and P 1154 mg.; for days 34–39, N_2 16.4 gm., Na 93 mEq., Cl 89 mEq., K 76 mEq., Ca 304 mg., and P 1196 mg.; and for days 40-45, N_2 16.1 gm., Na 96 mEq., Cl 91 mEq., K 78 mEq., Ca 273 mg., and P 1182 mg.

TABLE 6. METABOLIC DATA ON SUBJECT H. C.[1]

Period	Day	Weight of Patient	Urine Volume	Nitrogen			Sodium			Chloride			Potassium			Calcium			Phosphorus			Urinary Excretion				Serum					Blood Eosinophils
				Urine	Stool	Balance	Urine	Stool	Balance	Urine	Stool	Balance	Urine	Stool	Balance	Urine	Stool	Balance	Urine	Stool	Balance	Uric Acid	Glucose	17-Keto-steroids	Formalde-hydrogenic steroids	Potassium	Bicarbonate Content	pH	Uric Acid	Glucose	
		kg.	cc.	gm.	gm.	gm.	mEq.	mEq.	mEq.	mEq.	mEq.	mEq.	mEq.	mEq.	mEq.	mg.	mg.	mg.	mg.	mg.	mg.	gm.	gm.	mg.	mg.	mEq. /L	mEq. /L		mg. %	mg. %	cells/ cu. mm.
Control	7- 9	58.9	2215	12.7	1.8	+1.5	94	1	− 4	77	1	+ 4	54	15	+ 6	80	197	+ 10	845	369	+ 12	0.57	1.0	18	0.2	4.2	27	7.33	6.9	96	59
	10-12	58.8	2128	13.1	1.8	+1.1	86	1	+ 4	73	1	+ 8	55	15	+ 5	81	197	+ 9	812	369	+ 45	0.57	0.9	18	0.2						
	13-15	58.9	1995	13.0	1.8	+1.2	86	1	+ 4	73	1	+ 8	52	15	+ 8	78	197	+ 12	814	369	+ 43	0.54	1.0	18	0.2	3.5	25	7.41	7.0	87	76
	16	58.8	2225	14.8	1.6	−0.4	71	1	+ 19	74	1	+ 7	81	16	−22	81	203	+ 3	973	372	−119	0.86	1.6	31	4.2						
	17	58.9	2025	14.5	1.6	−0.1	29	1	+ 61	41	1	+ 40	71	16	−12	69	203	+ 15	845	372	+ 9	0.80	2.6	31	4.2						
	18	59.3	2150	14.7	1.6	−0.3	14	1	+ 76	41	1	+ 40	68	16	− 9	74	203	+ 10	941	372	− 87	0.94	7.3	31	4.2						
	19	59.3	2190	16.8	1.6	−2.4	58	1	+ 32	94	1	− 13	75	16	−16	100	203	− 16	913	372	− 59	0.94	3.0	39	8.6	3.6	27	7.40	5.8	114	5
	20	59.4	2020	16.8	1.6	−2.4	26	1	+ 64	58	1	+ 23	75	16	−16	100	203	− 16	913	372	− 59	0.94	4.0	39	8.6						
ACTH	21	59.5	2225	16.8	1.6	−2.4	89	1	+ 1	118	1	− 37	75	16	−16	100	203	− 16	913	372	− 59	0.94	2.0	39	8.6						
	22	59.5	2150	18.0	1.5	−3.5	34	1	+ 56	48	1	+ 33	61	14	0	87	194	+ 6	1038	370	−182	1.12	2.1	44	6.1	3.0	31	7.47	5.2	116	0
	23	59.8	2275	18.0	1.5	−3.5	58	1	+ 32	56	1	+ 25	61	14	0	87	194	+ 6	1038	370	−182	1.12	3.1	44	6.1						
	24	59.8	2385	18.0	1.5	−3.5	93	1	− 3	88	1	− 7	61	14	0	87	194	+ 6	1038	370	−182	1.12	5.6	44	6.1						
	25	59.7	2295	18.5	1.5	−4.0	69	1	+ 21	75	1	+ 6	83	14	−22	103	194	− 10	1277	370	−421	1.17	6.3	56	11.9						
	26	59.5	2425	18.7	1.5	−4.2	55	1	+ 35	61	1	+ 20	73	14	−12	83	194	+ 10	1205	370	−349	0.99	4.5	56	11.9	3.0	34	7.52	5.0	121	3
	27	59.3	2375	19.8	1.5	−5.3	94	1	− 4	95	1	− 14	75	14	−14	124	194	− 31	1085	370	−229	1.17	4.4	56	11.9						
	28	58.8	2510	17.4	2.2	−3.6	198	1	−108	154	1	− 73	27	17	+31	176	291	−180	524	517	+185	0.85	1.0	20	0.6	2.8	34	7.54	5.2	109	14
	29	58.5	2725	16.5	2.2	−2.7	267	1	−177	183	1	−102	32	17	+26	158	291	−162	834	517	−125	1.08	1.0	20	0.6						
	30	57.7	2260	15.4	2.2	−1.6	115	1	− 25	56	1	+ 25	28	17	+30	78	291	− 82	984	517	−275	0.91	1.2	20	0.6	3.0	31	7.47	5.4	88	59
	31	57.3	1770	14.0	2.2	−0.2	60	1	+ 30	18	1	+ 63	33	17	+25	44	291	− 48	855	517	−146	0.85	1.2	18	0.4						
Re-	32	57.4	2140	13.4	2.2	+0.4	79	1	+ 11	20	1	+ 61	35	17	+23	53	291	− 57	706	517	+ 3	0.87	1.0	18	0.4						
covery	33	57.7	2345	13.2	2.2	+0.6	89	1	+ 1	38	1	+ 43	40	17	+18	55	291	− 59	713	517	− 4	0.87	1.1	18	0.4						
	34-36	57.4	2300	12.8	1.9	+1.3	119	1	− 29	92	1	− 11	54	17	+ 4	60	265	− 38	777	471	− 22	0.78		18	0.4	4.2	26	7.42	5.6	88	76
	37-39	56.9	2230	12.4	1.9	+1.7	92	1	− 2	88	1	− 7	63	17	− 5	75	265	− 53	815	471	− 60	0.64		16	0.4						
	40-42	56.6	1957	12.0	1.9	+2.1	70	1	+ 20	68	1	+ 13	56	16	+ 3	76	255	− 44	802	404	+ 20	0.51		19	0.5	4.2	25	7.37	6.4	91	69
	43-45	57.1	2040	11.4	1.9	+2.7	72	1	+ 18	67	1	+ 14	51	16	+ 8	86	255	− 54	714	404	+108	0.61		18	0.8	4.0	26	7.41	6.5	84	78
	46	57.3																													

[1] Daily intakes were N_2 16.0 gm., Na 91 mEq., Cl 82 mEq., K 75 mEq., Ca 287 mg.. and P 1226 mg.

TABLE 7. METABOLIC DATA ON SUBJECT J. M.[1]

Period	Day	Weight of Patient	Urine Volume	Nitrogen			Sodium			Chloride			Potassium			Calcium			Phosphorus			Urinary Excretion				Serum					Blood Eosinophils
				Urine	Stool	Balance	Urine	Stool	Balance	Urine	Stool	Balance	Urine	Stool	Balance	Urine	Stool	Balance	Urine	Stool	Balance	Uric Acid	Glucose	17-Keto-steroids	Formalde-hydrogenic steroids	Potassium	Bicarbonate Content	pH	Uric Acid	Glucose	
		kg.	cc.	gm.	gm.	gm.	mEq.	mEq.	mEq.	mEq.	mEq.	mEq.	mEq.	mEq.	mEq.	mg.	mg.	mg.	mg.	mg.	mg.	gm.	gm.	mg.	mg.	mEq./L	mEq./L		mg. %	mg. %	cells/cu. mm.
Control	7- 9	58.2	2055	12.7	1.3	+2.0	68	1	+ 22	59	1	+ 22	53	12	+10	74	207	+ 6	715	414	+ 97	0.72	1.0	23	0.1	4.5	26	7.33	5.1	91	254
	10-12	58.4	2042	12.7	1.3	+2.0	83	1	+ 7	69	1	+ 12	54	12	+ 9	62	207	+ 18	692	414	+120	0.60	1.4	23	0.1						
	13-15	58.2	1803	12.2	1.3	+2.5	78	1	+ 12	67	1	+ 14	51	12	+12	77	207	+ 3	736	414	+ 76	0.71	1.3	23	0.1	4.3	27	7.41	5.6	93	200
ACTH	16	58.3	1700	13.5	1.4	+1.1	63	1	+ 27	56	1	+ 25	70	13	− 8	65	220	+ 2	745	448	+ 33	0.84	1.3	26	2.7						
	17	58.5	2225	13.6	1.4	+1.0	45	1	+ 45	48	1	+ 33	60	13	+ 2	80	220	− 13	663	448	+115	0.77	2.0	26	2.7						
	18	58.9	1990	13.8	1.4	+0.8	28	1	+ 62	45	1	+ 36	58	13	+ 4	90	220	− 23	646	448	+132	0.81	5.5	26	2.7						
	19	59.0	1760	13.2	1.4	+1.4	28	1	+ 62	46	1	+ 35	55	13	+ 7	102	220	− 35	602	448	+176	0.69	4.6	33	6.8	4.5	26	7.39	4.2	97	20
	20	59.5	1830	13.2	1.4	+1.4	28	1	+ 62	46	1	+ 35	55	13	+ 7	102	220	− 35	602	448	+176	0.69	3.2	33	6.8						
	21	60.1	2120	13.2	1.4	+1.4	28	1	+ 62	46	1	+ 35	55	13	+ 7	102	220	− 35	602	448	+176	0.69	3.2	33	6.8						
	22	60.1	2365	14.7	1.6	−0.3	34	1	+ 56	47	1	+ 34	59	15	+ 1	105	260	− 78	714	537	− 25	0.97	1.6	36	5.3	4.1	28	7.45	3.8	105	11
	23	60.1	1630	14.7	1.6	−0.3	34	1	+ 56	47	1	+ 34	59	15	+ 1	105	260	− 78	714	537	− 25	0.97	2.2	36	5.3						
	24	60.7	2135	14.7	1.6	−0.3	34	1	+ 56	47	1	+ 34	59	15	+ 1	105	260	− 78	714	537	− 25	0.97	6.4	36	5.3						
	25	60.8	1935	14.1	1.6	+0.3	43	1	+ 47	46	1	+ 35	56	15	+ 4	92	260	− 65	760	537	− 71	0.93	4.5	40	5.5						
	26	60.9	1720	15.1	1.6	−0.7	60	1	+ 30	60	1	+ 21	54	15	+ 6	108	260	− 81	813	537	−124	0.93	3.3	40	5.5	3.9	29	7.43	3.9	97	315
	27	61.4	2480	15.0	1.6	−0.6	63	1	+ 27	53	1	+ 28	55	15	+ 5	89	260	− 62	908	537	−219	0.93	6.4	40	5.5						
Recovery	28	61.0	2780	12.7	1.6	+1.7	186	2	− 97	127	1	− 46	16	14	+45	164	243	−120	445	430	+351	0.66	0.8	22	1.0	3.8	30	7.48	3.8	83	140
	29	60.5	4475	14.2	1.6	+0.2	497	2	−408	387	1	−306	39	14	+22	163	243	−119	693	430	+103	0.99	1.1	22	1.0						
	30	58.2	2515	14.2	1.6	+0.2	236	2	−147	140	1	− 59	40	14	+21	73	243	− 29	973	430	−177	0.90	2.1	22	1.0	4.2	29	7.45	4.5	93	268
	31	57.5	2490	15.7	1.6	−1.3	162	2	− 73	128	1	− 47	59	14	+ 2	62	243	− 18	920	430	−124	0.92	2.6	19	0.5						
	32	56.9	2120	15.8	1.6	−1.4	100	2	− 11	82	1	− 1	65	14	− 4	45	243	− 1	839	430	− 43	0.98	1.9	19	0.5						
	33	56.7	1860	16.0	1.6	−1.6	48	2	+ 41	51	1	+ 30	67	14	− 6	32	243	+ 12	929	430	−133	0.69	1.7	19	0.5						
	34-36	56.9	1750	15.3	2.1	−1.4	32	1	+ 58	35	1	+ 46	65	16	− 6	40	299	− 52	785	510	− 69	0.84		18	0.3	5.0	26	7.43	3.9	100	131
	37-39	57.6	1883	13.0	2.1	+0.9	56	1	+ 34	52	1	+ 29	55	16	+ 4	33	299	− 45	535	510	+181	0.77		19	0.1						
	40-42	57.6	2070	12.1	1.8	+2.1	82	4	+ 5	73	2	+ 7	53	16	+ 6	56	296	− 65	653	496	+ 77	0.73		14	0.6	5.1	26	7.34	4.2	100	373
	43-45	57.7	2053	11.6	1.8	+2.6	87	4	0	77	2	+ 3	53	16	+ 6	71	296	− 80	678	496	+ 52	0.70		17	0.6	5.1	28	7.38	4.8	92	348
	46	57.5																													

[1] Daily intakes were N_2 16.0 gm., Na 91 mEq., Cl 82 mEq., K 75 mEq., Ca 287 mg., and P 1226 mg.

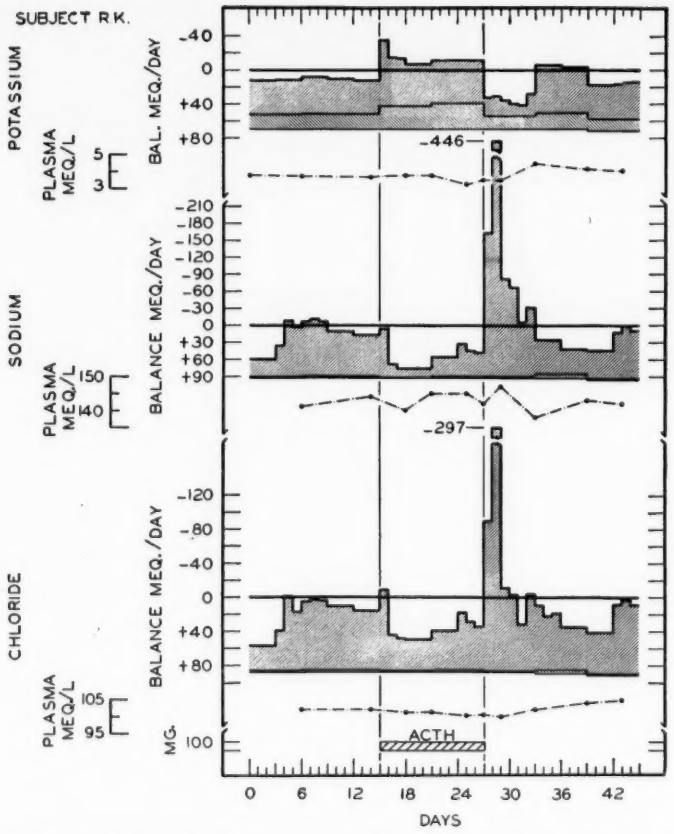

FIG. 1. Subject R. K., 31 yrs. old. Effect of ACTH on Na, Cl, and K balances and serum Na, Cl, and K.

The balance charts in this and subsequent figures are constructed in the following manner. Intake is plotted down from the zero line, fecal output is plotted up from the intake line, and urinary output is plotted up from fecal output. Thus a hatched area above the zero line represents negative balance, and a clear area below the zero line indicates positive balance.

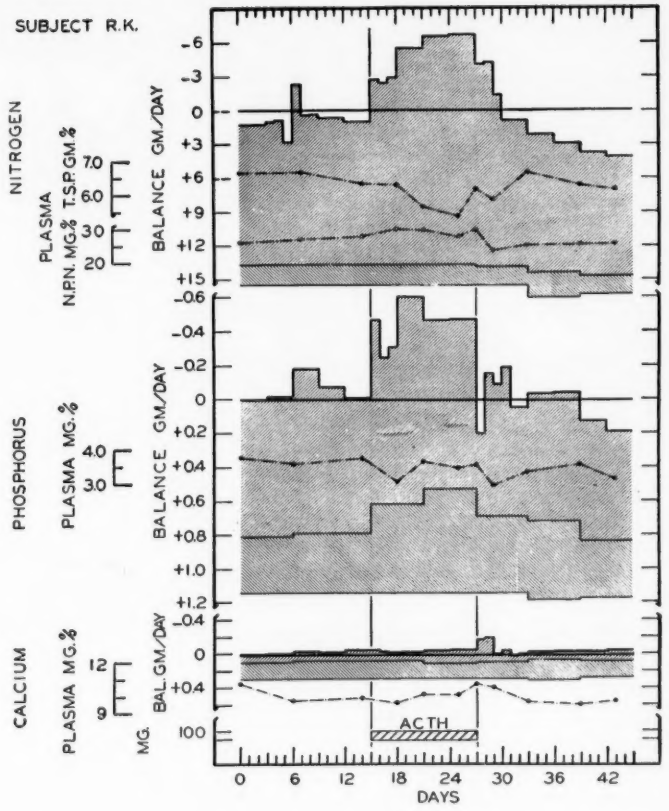

FIG. 2. Subject R. K., 31 years old. Effect of ACTH on N, P, and Ca balances and serum protein, non-protein nitrogen, P, and Ca.

balance.

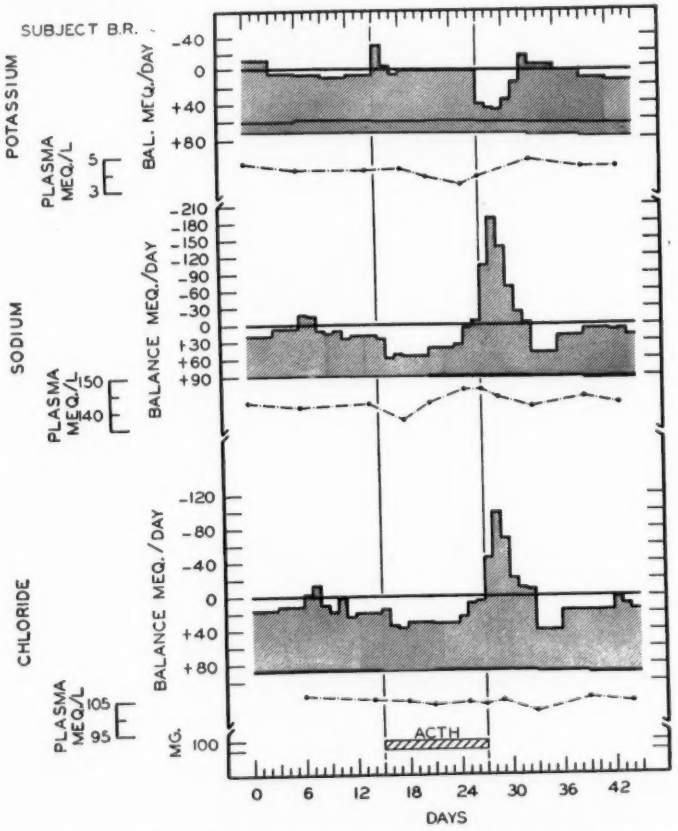

FIG. 3. Subject B. R., 32 years old. Effect of ACTH on Na, Cl, and K balances and serum Na, Cl, and K.

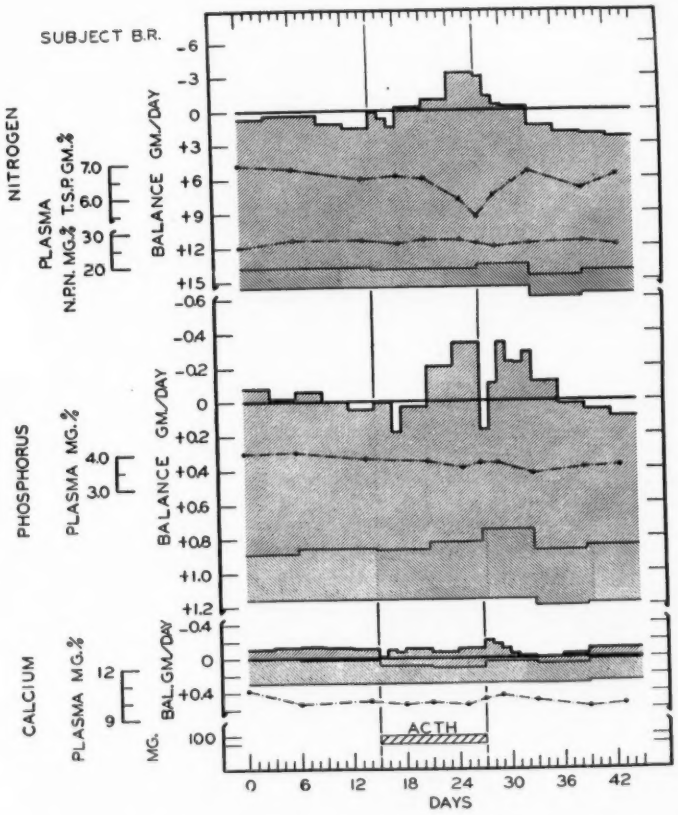

FIG. 4. Subject B. R., 32 years old. Effect of ACTH on N, P, and Ca balances and serum protein, non-protein nitrogen, P, and Ca.

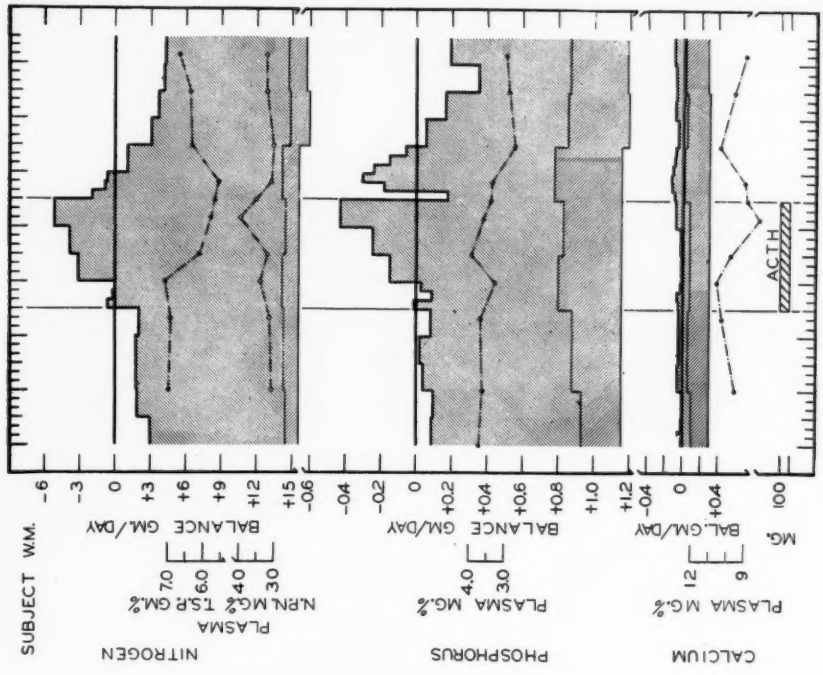

FIG. 6. Subject W. M., 65 years old. Effect of ACTH on N, P, and Ca balances and serum protein, non-protein nitrogen, P, and Ca.

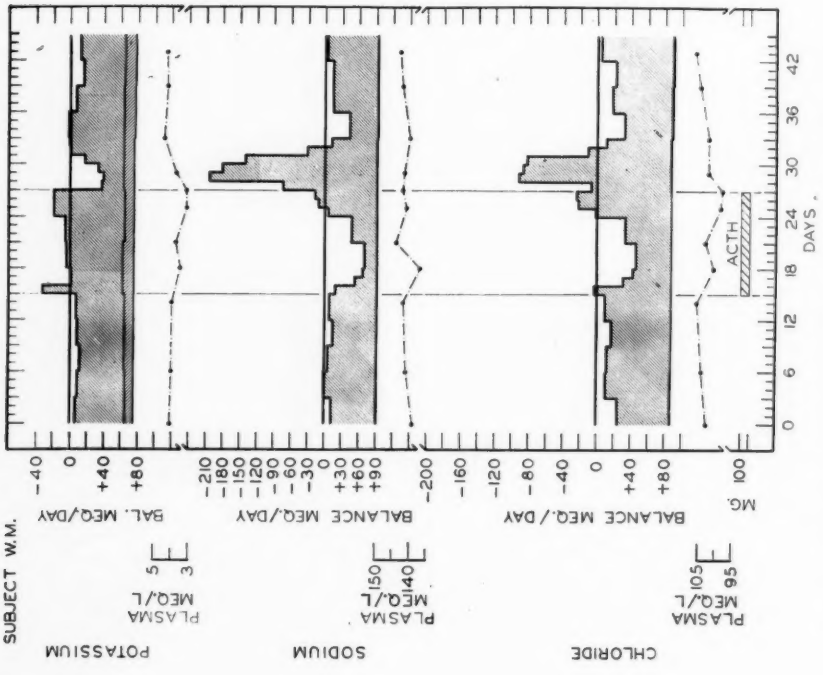

FIG. 5. Subject W. M., 65 years old. Effect of ACTH on Na, K, and Cl balances and serum Na, K, and Cl.

FIG. 6. Subject W. M., 65 years old. Effect of ACTH on N, P, and Ca balances and serum protein, non-protein nitrogen, P, and Ca.

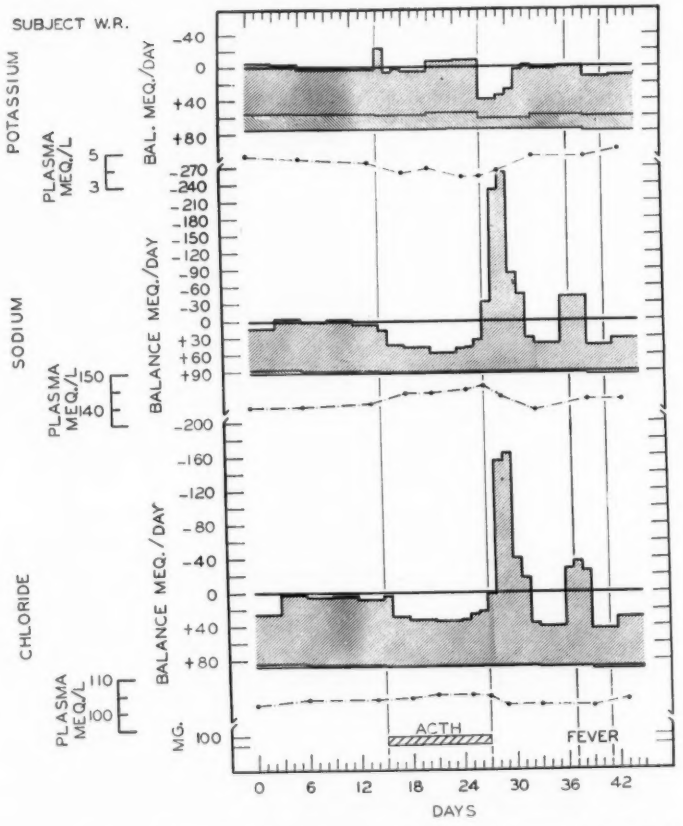

FIG. 7. Subject W. R., 63 years old. Effect of ACTH on Na, K, and Cl balances and serum Na, K, and Cl.

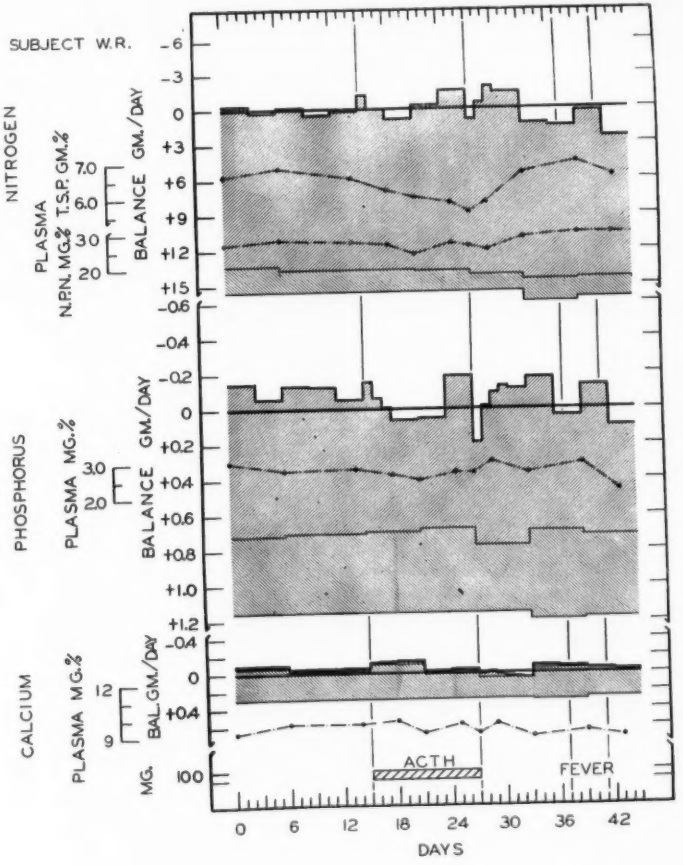

FIG. 8. Subject W. R., 63 years old. Effect of ACTH on N, P, and Ca balances and serum protein, non-protein nitrogen, P, and Ca.

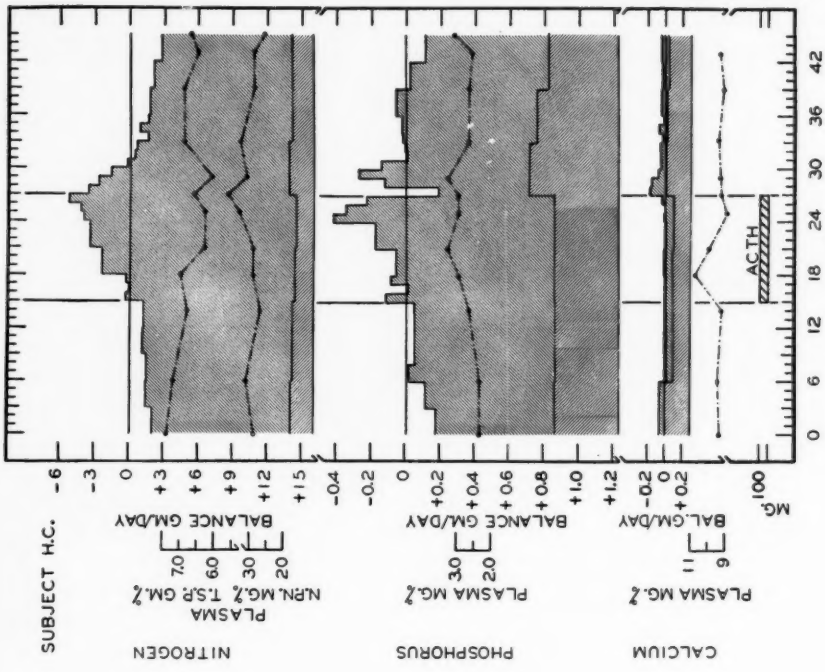

FIG. 10. Subject H. C., 64 years old. Effect of ACTH on N, P, and Ca balances and serum protein, non-protein nitrogen, P, and Ca.

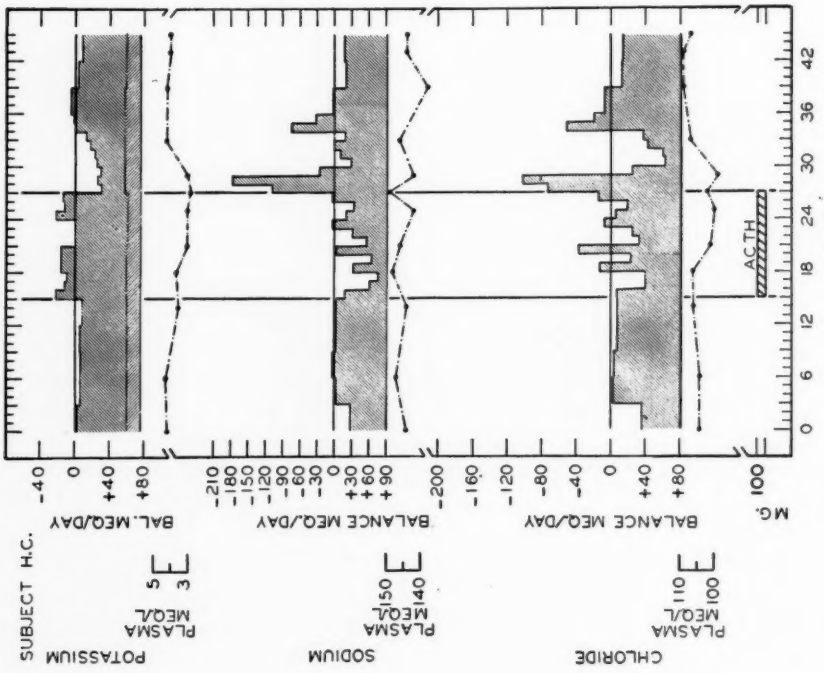

FIG. 9. Subject H. C., 64 years old. Effect of ACTH on Na, K, and Cl balances and serum Na, K, and Cl.

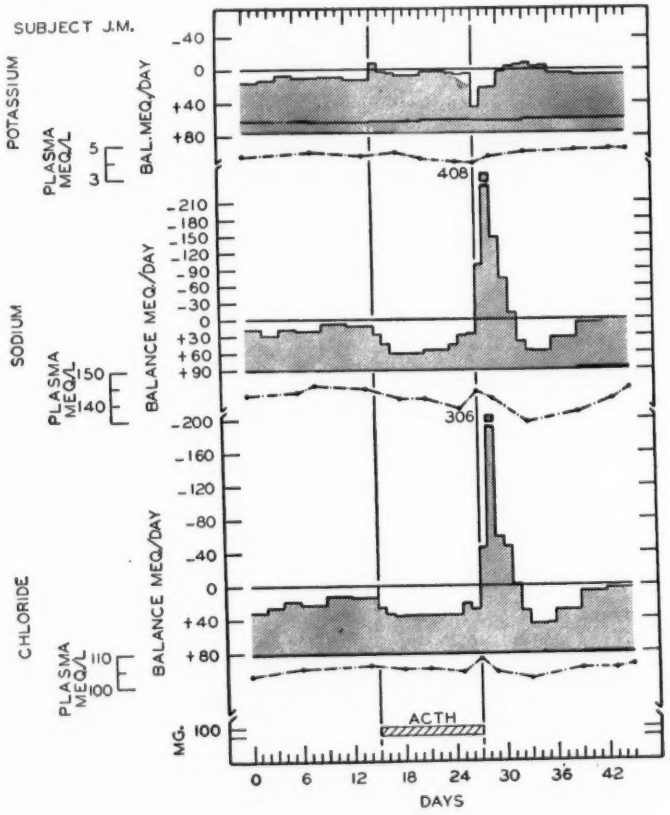

FIG. 11. Subject J. M., 72 years old. Effect of ACTH on Na, K, and Cl balances and serum Na, K, and Cl.

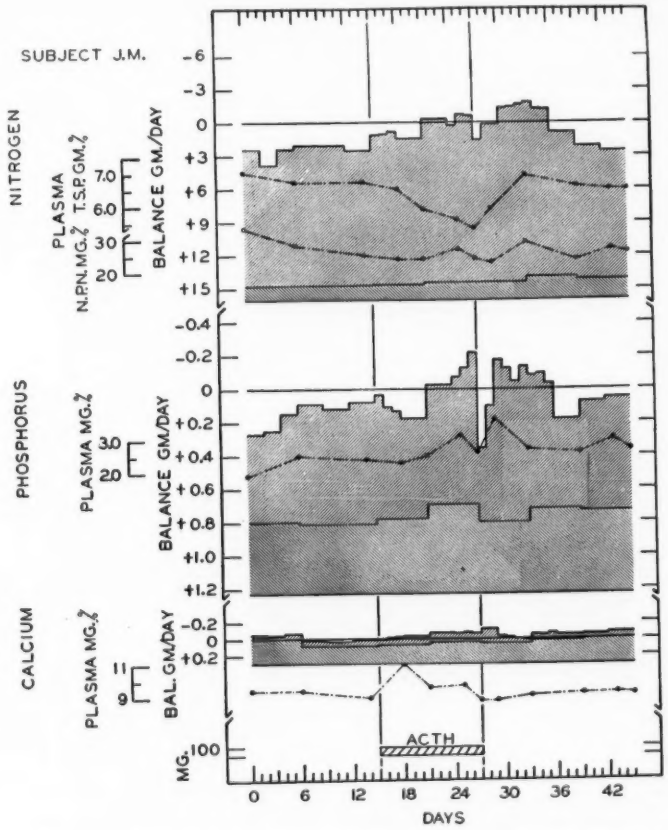

FIG. 12. Subject J. M., 72 years old. Effect of ACTH on N, P, and Ca balances and serum protein, non-protein nitrogen, P, and Ca.

ance were negative in 4 subjects throughout the period of ACTH administration and were negative in B. R. and J. M. through the ninth and tenth days of that period, respectively. During the entire ACTH period the negative potassium balance not explained by loss of nitrogen was for R. K. 96 mEq., for B. R. 51 mEq., for W. M. 73 mEq., for W. R. 59 mEq., for H. C. 82 mEq., and for J. M. 25 mEq.

All subjects had a fall in serum potassium and a rise in serum bicarbonate content and serum pH. The difference between serum sodium and chloride tended to increase, and the partial pressure of CO_2 was not significantly altered.

Nitrogen loss developed slowly on ACTH, was maximal during the last three days of administration, and continued for at least three

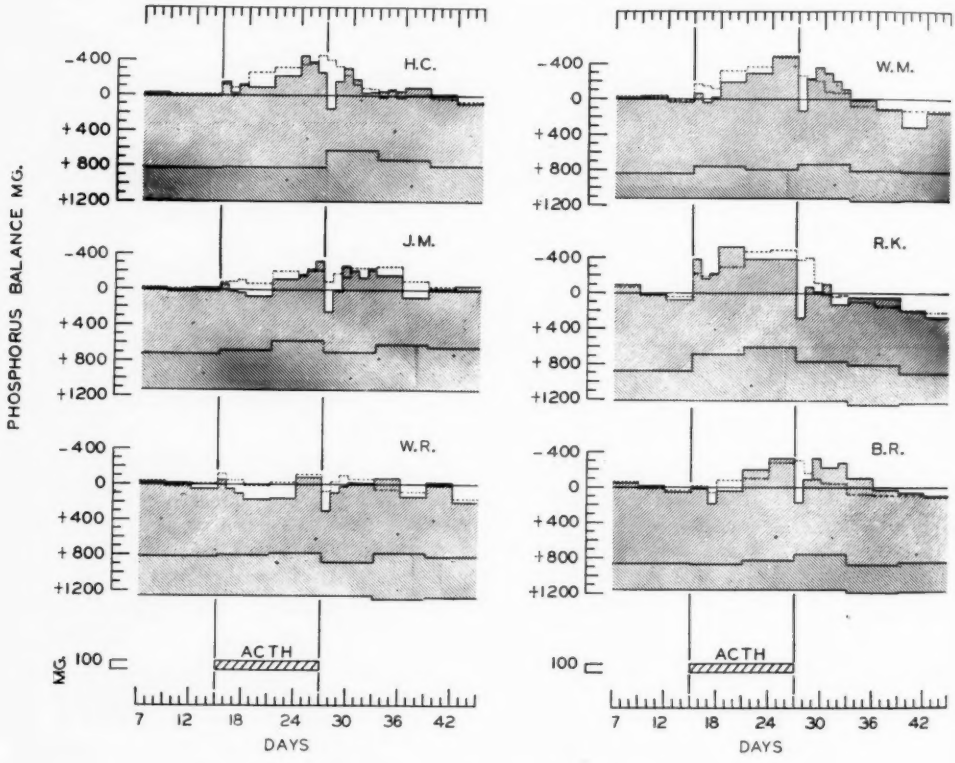

FIG. 13. Comparison of the observed phosphorus balances with that expected from the nitrogen and calcium balances.

The observed daily phosphorus balance is shown as the variation from the average phosphorus balance of the pre-ACTH period. The intake, minus or plus an adjustment necessary to make the overall balance of the pre-ACTH period zero, is plotted down from the zero line. Fecal excretion is plotted up from this adjusted intake line, and urinary excretion is plotted up from fecal excretion. Hatched areas above the zero line represent negative balances and clear areas below the zero line indicate positive balances. The phosphorus balance expected from the loss of nitrogen and calcium is plotted as a broken line. The nitrogen and calcium balances used in these calculations were the variations of the daily balances from the average balances of the control period.

days after withdrawal of ACTH. Subsequently there was nitrogen retention.

All subjects except W. R., whose nitrogen loss was small, had an increased loss of phosphorus during the administration of ACTH and the first part of the recovery period. Thereafter there was retention of phosphorus. In each case the loss of phosphorus was interrupted by a day of retention immediately following withdrawal of ACTH.

The theoretical phosphorus balances based on nitrogen balances and calcium balances are compared with the observed phosphorus balances in figure 13. These theoretical phosphorus balances were those that would be expected if phosphorus were lost with nitrogen in the ratio in which they are assumed to exist in protoplasm ($\frac{N}{P} = 15$) and with calcium in the ratio that presumably exists in bone ($\frac{Ca}{P} = 2.23$) (26). The over-all theoretical and actual phosphorus balances during the periods of negative nitrogen balance agreed well with a discrepancy in no case greater than 10 per cent of the intake. The only deviation of observed from theoretical balance consistent and striking enough to justify comment is the marked retention of phosphorus not explained on the basis of nitrogen and calcium which occurred in every case on the first day following the withdrawal of ACTH.

The urinary excretion of calcium was increased during the administration of ACTH and the first part of the recovery period. However, there was no consistent change in the balances due probably to the fact that the magnitude of the urinary changes was small compared to the demarcation errors in fecal collections.

Uric acid excretion was increased during the ACTH period and the first part of the recovery period. In each case there was diminution in uric acid excretion on the first day of the recovery period.

The serum uric acid decreased progressively during the period of ACTH administration and subsequently gradually returned towards control values.

The excretion of 17-ketosteroids and formaldehydogenic steroids rose progressively during the administration of ACTH and fell rather rapidly to control levels during the recovery period. Steroid excretion is shown in figure 14.

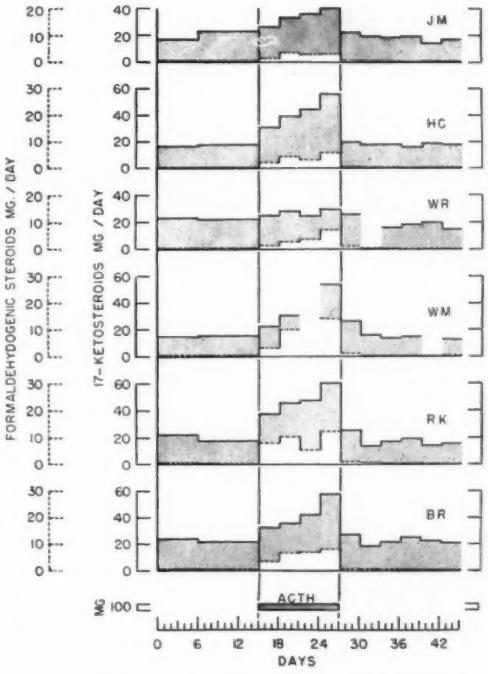

FIG. 14. Effect of ACTH on urinary 17-ketosteroid excretions and formaldehydogenic steroid excretions.

17-ketosteroid excretions are charted as hatched areas. Formaldehydogenic steroid excretions are superimposed as clear areas.

The plasma glucose rose in all subjects during the administration of ACTH and subsequently fell promptly to control levels. The urinary reducing substance not fermentable by yeast was determined at intervals in the various periods and showed no change. The change in reducing substance may, therefore, be attributed to glucose. During the administration of ACTH each subject had increased urinary excretion of glucose which returned to the con-

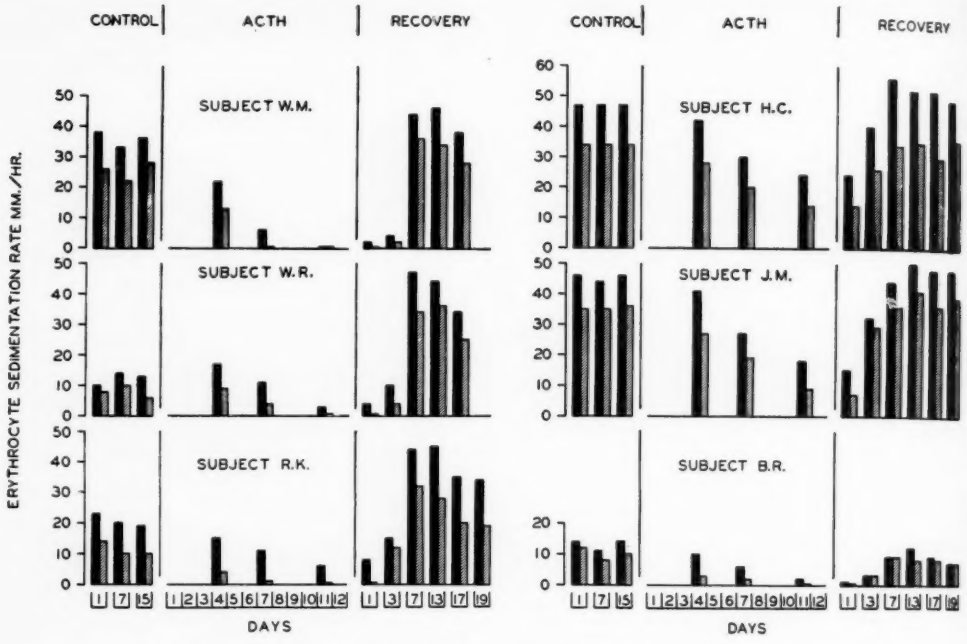

FIG. 15. Effect of ACTH on sedimentation rate.

Observed sedimentation rates are shown as solid bars and corrected sedimentation rates as hatched bars. The small clear areas represent sedimentation rates of 0 mm. per hr.

trol value on the first day of the recovery period.[2]

The total serum protein, albumin, and globulin fell during the administration of ACTH and subsequently returned to the control level.

Hematologic Studies.—Four subjects showed marked, sustained eosinopenia on ACTH. W. M., had eosinopenia until late in the period of ACTH administration. W. R. showed little eosinopenia; the maximum decrease was only 52 per cent of the average control value and was not sustained. In general the eosinophil count rose promptly to control values in the recovery period.

Early during the administration of ACTH the neutrophil count rose in each case to a level which it maintained with little variation until the withdrawal of ACTH at which time it fell to the control value except in several of the cases in which intercurrent infections occurred. The average neutrophil count during ACTH administration was approximately twice the control value in every case except that of J. M., who had only a slight increase. On ACTH there was no consistent or striking change in the lymphocyte count.

The observed and corrected sedimentation rates fell strikingly and progressively in all subjects on ACTH. Following withdrawal of ACTH they rose to or above control values. The changes in sedimentation rates are shown in figure 15.

Changes in the hematocrit on ACTH administration were small and in no instance exceeded 4 mm. in a 100 mm. hemotocrit tube. On the third day after ACTH there were in sev-

[2] The values reported as "urinary glucose" in the tables represent total reducing substances. Reducing substances not fermentable by yeast represented approximately the equivalent of 0.6 gm. glucose and did not change during ACTH administration.

eral instances slight increases in the hematocrits over the average control values. In no case did this exceed 5 mm.

Comparison of Responses to ACTH by Young and Old Subjects.—The duration of the response to ACTH was essentially the same in young and old subjects. Increased steroid excretion persisted in all cases until after withdrawal of ACTH. There was no age trend in the duration of the other metabolic and hematologic responses to ACTH.

To facilitate comparison of the magnitudes of the responses of young and old individuals quantitative measures of a number of responses are recorded in table 8 and plotted against age in figure 16. To construct this figure, sodium and chloride retention, nitrogen loss, potassium loss not due to protoplasmic destruction, urinary uric acid excretion, urinary glucose excretion, and urinary steroid excretion were computed as the maximal cumulative change from the values of the control period and eosinophil decrease was calculated as the maximum percentage decrease occurring during ACTH administration. These scatter plots show the wide variation in the responses of individuals to ACTH administration even when the same preparation of ACTH is administered under essentially identical dietary and other conditions. However it is apparent from inspection of these plots that the variation shows no age trend. Since 1 of the 2 young

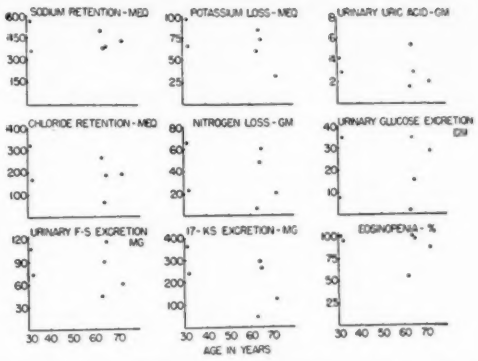
SODIUM RETENTION - MEQ
POTASSIUM LOSS - MEQ
URINARY URIC ACID - GM
CHLORIDE RETENTION - MEQ
NITROGEN LOSS - GM
URINARY GLUCOSE EXCRETION GM
URINARY F-S EXCRETION MG
17- KS EXCRETION - MG
EOSINOPENIA - %
30 40 50 60 70
AGE IN YEARS

FIG. 16. Scatter plots of various responses against age. The variables are, with the exception of eosinophil decrease, the maximum cumulative changes occurring during the administration of ACTH. Their computation is described in the text. Eosinophil decrease is expressed as the maximum percentage decrease occurring during ACTH administration.

TABLE 8. COMPARISON OF RESPONSES OF SUBJECTS TO ACTH.[1]

Variables	Subjects					
	R. K. 31 yrs. 71 kg.	B. R. 32 yrs. 53 kg.	W. M. 65 yrs. 58 kg.	W. R. 63 yrs. 59 kg.	H. C. 64 yrs. 59 kg.	J. M. 72 yrs. 58 kg.
Na Bal. mEq	+560	+359	+401	+507	+383	+424
Cl Bal. mEq.	+319	+166	+190	+262	+ 66	+193
K Bal. mEq.	− 96	− 66	− 73	− 59	− 84	− 32
N_2 Bal. gm.	− 65	− 23	− 60	− 6	− 48	− 21
Urinary Uric Acid gm.	4.2	2.9	2.9	1.6	5.4	2.0
Urinary Glucose gm.	8	35	16	2	35	29
Decrease in Eosinophils %	100	98	99	52	100	95
Urinary F. S. mg.	108	74	117	44	90	60
Urinary 17-KS. mg.	363	243	267	48	294	129

[1] The variables are, with the exception of eosinophil decrease, the maximum cumulative changes occurring during the administration of ACTH. Their computation is described in the text. Eosinophil decrease is expressed as the maximum percentage decrease occurring during ACTH administration.

The formaldehydogenic steroid excretion (F. S.) and 17-ketosteroid excretion (17-KS.) values for one 3 day period for W. M. were not obtained due to a laboratory accident. In the construction of this table an estimate of these values was obtained by averaging the values of the 3 day period which preceded the last period and the 3 day period which followed it.

men was the heaviest subject and the other the lightest similar plots were drawn with the data expressed on a weight basis. Though this treatment reduced the variation in some measures, it did not reveal an age trend. No age trend existed in the other data obtained in this study and not illustrated in these plots.

Discussion

The evidence which bears on adrenocortical function in elderly individuals has been obtained almost exclusively by morphologic studies and by the determination of urinary steroid excretion in individuals under no stress. The low resistance of elderly individuals to disease and trauma admits of so many possible explanations that it cannot be taken as evidence of decreased adrenocortical responsiveness. Although morphologic changes appear in the adrenals with age (5), they do not permit an estimate of the functional activity of these glands. The decrease in urinary 17-ketosteroid excretion in elderly men and women (10, 11, 15, 17, 18) is difficult to interpret, and the absence of change in corticosteroid excretion with age (23) does not indicate that the ability to respond to stress with increased adrenocortical activity is unimpaired.

The development of ACTH for human study has made possible the study of adrenocortical responsiveness as a function of age. No definite evidence of impairment with age of the adrenocortical response to brief stimulation with ACTH was found in a previous study from this laboratory (28).

The present study presents data which permit a comparison of the response of young and elderly individuals to the chronic administration of ACTH. The increase in adrenocortical activity as estimated by urinary steroid excretion and the metabolic and hematologic changes resulting from increased adrenocortical activity were essentially the same in young and old. These results, although on a small number of subjects, suggest that the adrenocortical response of elderly men to stimulation via the pituitary is not only adequate in magnitude but well-sustained.

Although the primary purpose of this study was to compare the responsiveness of young and elderly individuals to ACTH certain other aspects of the results require comment.

There were two clinical observations of particular interest. The first was the mood change which occurred in 4 subjects and was rather striking in 1 of the subjects whose mood was excessively cheerful during ACTH administration and sullen following its withdrawal. The occurrence of this mood change where no therapeutic benefit was expected or received is in accord with the concept that it is due to increased adrenocortical activity rather than the normal response to therapeutic benefit experienced.

The other clinical observation of interest was the high incidence of respiratory infections following the withdrawal of ACTH. This suggests either that resistance to infection was lowered during the administration of ACTH with delay of inflammatory response until after withdrawal of ACTH, or that resistance to infection was lowered after withdrawal of ACTH.

The over-all metabolic changes induced by ACTH need not be commented on. In agreement with previously reported results, our data show that the retention of sodium and chloride is not in the ratio that would be expected if no intracellular movement of these ions was involved (1, 25), and that potassium is lost in excess of the amount expected from nitrogen loss (1, 25). Phosphorus was in general lost in an amount expected from the nitrogen loss observed except on the day following ACTH withdrawal when there was retention of phosphorus unexplained by changes in nitrogen and calcium balance.

The hematologic changes observed were in general those expected on the basis of earlier work (14). However, the reduction in sedimentation rate observed in our subjects was unexpected and is of interest not only as a physiologic manifestation but also in connection with the interpretation frequently placed on sedimentation rate changes in patients treated with ACTH. Prior to the administra-

tion of ACTH the sedimentation rates in R. K., B. R., and W. R., were at the upper limits of the normal range when expressed for a hematocrit of 47 per cent. The elevation of sedimentation rate present in J. M. and H. C. prior to ACTH may have been due to their mild chronic respiratory infections. The moderate elevation of sedimentation rate in W. M. was unexplained. On ACTH in every case there was a striking reduction in sedimentation rate. In 4 of the subjects the corrected sedimentation rate reached zero, and in 1 subject the absolute rate reached zero. Following withdrawal of ACTH the sedimentation rates rose to or above the control values. This reduction in sedimentation rate does not seem dependent on the presence of an effect of ACTH on disease process since some of the subjects in whom it occurred had no evidence of disease and since the sedimentation rates were in many instances reduced to subnormal values. The reduction in sedimentation rate may be dependent on a reduction in plasma fibrinogen. Such a reduction in plasma fibrinogen during the administration of ACTH has been observed in anterior pituitary deficiency (24) as well as in patients with inflammatory disease, and quite possibly occurs in healthy subjects.

Summary

A comparative study of the hematologic and metabolic responses to the chronic administration of ACTH in 2 young and 4 elderly men is reported.

There was no evidence of impairment with age of the magnitude and duration of either the adrenocortical response or the metabolic and hematologic effects resulting from increased adrenocortical activity.

Reduction of erythrocyte sedimentation rate is a manifestation of increased adrenocortical activity.

From the Section on Gerontology, National Heart Institute, National Institutes of Health, P.H.S., F.S.A., Bethesda, Maryland, and the Baltimore City Hospitals, Baltimore, Maryland.

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Effects of Administration of Testosterone Propionate on the Testicles in the Senescent Male

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With the increased use of testosterone propionate in many conditions found in the aging male, a study of the effects of this hormone upon the testes in older men would seem to be of value. Numerous workers have studied the effects of testosterone propionate on the testes of experimental animals. Among these are: Dovoskin (1, 2); Gershon-Cohen (3); Greene and Burill (4); Leathem (9); Paschkis and Fels (13); Rubinstein and Kurland (14); Selye and Friedman (16); Shay (17); Smith (18); and Wilson and Wilson (19). Others have studied the effect of this hormone on spermatogenesis in man, namely Heckel (5, 6); Hotchkiss (8); McCullagh and McCurl (10, 11); and Rubinstein and Kurland (15).

Our study included 27 males ranging in age from 60 to 85 years, with an average age of 67. Various doses of testosterone propionate were given, ranging from 5 mg. 4 times weekly to 25 mg. 7 times weekly. In addition, testosterone propionate was given in conjunction with chorionic gonadotropin to 4 patients. All hormone therapy was administered intramuscularly. Twenty-one of the series had a biopsy prior to the administration of hormone. The hormone was then given for a period of three months, and at the end of that period a second biopsy was made. Two of the series received testosterone for a period of six months, and 4 for a period of four months. These did not have a preliminary biopsy. The results of the above study are tabulated in table 1.

All biopsies made prior to treatment showed changes characteristic of aging in the testicles, namely thickening of the basement membrane with a moderate decrease in spermatogenesis. These changes were extremely variable, and in some instances the testicles were almost normal in appearance.

Cases listed as atrophy following therapy

Table 1. Composite Results of Androgen Therapy

Dosage	Number of Cases	No Change	Atrophy	Increased Mitoses
25 mg. 7 x weekly	2	1	1	—
25 mg. 6 x weekly	1	—	—	1
25 mg. 5 x weekly	4	1	2	1
25 mg. 4 x weekly	4	2	2	—
25 mg. 3 x weekly	8	4	4	—
5 mg. 4 x weekly	4	2	2	—
25 mg. 5 x weekly plus Antuitrin S U 500 3 x weekly	4	2	—	2
Totals	27	12	11	4

Total studied with androgens, 27. Majority studied for a period of 3 months between, before and after biopsy, 2 for 6 months, 4 for 4 months. (No preliminary biopsy in this series.)

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presented a marked decrease to a complete loss of the germinal elements, the basement membrane with a few Sertoli cells being the only remaining structure. There was some edema of the intertubular spaces with an apparent decrease in the number of Leydig's cells. This latter finding is difficult to evaluate from a single section and was so indefinite in character that no emphasis is placed on it. Figures 1, 2, 3, and 4 demonstrate the changes which were characteristically found. Figure 5 shows a section taken from a patient who received prolonged estrogen therapy, 6000 R. U. 3 times weekly, for three months. Noteworthy is the similarity of changes in the germinal epithelium between those patients receiving androgen therapy and those receiving estrogen.

In analyzing our various results, we noted that approximately 50 per cent of the subjects showed atrophy of the germinal epithelium, irrespective of the dosage used. Therefore, we may conclude that in doses varying from 5 mg. 4 times weekly, to 25 mg. 7 times weekly there is very little variation in the physiologic effect on the testicle. This finding is at variance with the experimental work of Wilson and Wilson (19), who administered testosterone propionate to immature mice in doses ranging from .75 mg. to 36 mg. given subcutaneously by injection of 1/12 the total dose 3 times weekly for four weeks. They reported a reduction of testis size in rats with the small doses of testosterone propionate, but no change where larger doses were used. They attribute this paradox to the assumption that small doses are sufficient to suppress pituitary gonadotropic function but are inadequate to maintain the gonads, whereas large amounts of androgens were believed to have sufficient direct gonadotropic action to maintain the testes even though the secretion of the pituitary gonadotropin was completely suppressed. Their findings were also confirmed by Greene and Burrill (4). Rubinstein and Kurland (14), experimenting with rats, found a marked variation in the effects of testosterone on testis weight and observed a stimulation with the smaller doses but a depression with doses of 5 mg. However, this depression was progressively greater when doses larger than 5 mg. were used. It was their opinion that there was a direct stimulating effect upon the testes with small doses of androgen, but when the doses were increased in the intact animal, the pituitary gland was depressed and the testes were inhibited in growth.

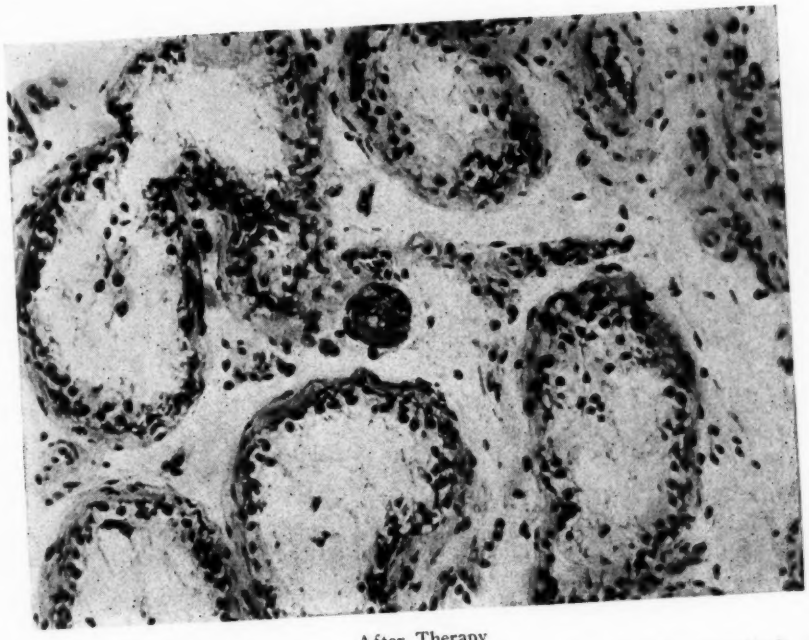
In the present study changes in the interstitial cells of Leydig were very indefinite, but one wonders if once the older male has been started on testosterone propionate therapy, it may be necessary that he receive this therapy for the balance of his life due to inactivation of the remaining hormonal activity present in the testicle.

The protective action of chorionic gonadotropin is noted in the 4 cases receiving 25 mg. of testosterone 5 times weekly plus Antuitrin S. U. 500, 3 times weekly. In this series, there were no cases of atrophy. Two showed no change. The other 2 showed a complete arrest of spermatogenesis but a marked increase in mitotic activity of the germinal epithelium (fig. 6).

Literature on the relation of the pituitary gland to the testicle is voluminous. However, the consensus seems to be that the spermatic elements in animals and man are under the influence of: 1), gonadotrophic hormone elaborated by the pituitary gland, and 2), a direct action of androgenic hormones. The latter premise has been proved rather conclusively by such workers as Dvoskin (1, 2), Leathem (9), Moore and Price (12), Seley and Friedman (16), and Smith (18), all of whom demonstrated that testicular atrophy could be prevented in hypophysectomized animals by the administration of adequate doses of testosterone propionate.

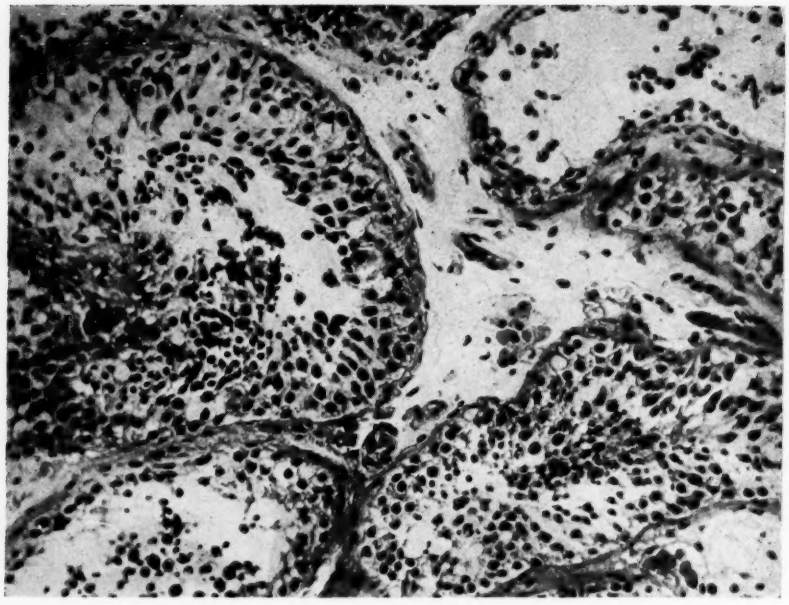
Moore and Price (12), Seley and Friedman (16), and Rubinstein and Kurland (15), all pointed out that there was a definite inhibition of the pituitary following the administration of testosterone propionate in larger doses. These findings have been applied clinically by Heller and Nelson (7), in the treatment of hypogonadotropic eunuchoids and the male

Before Therapy

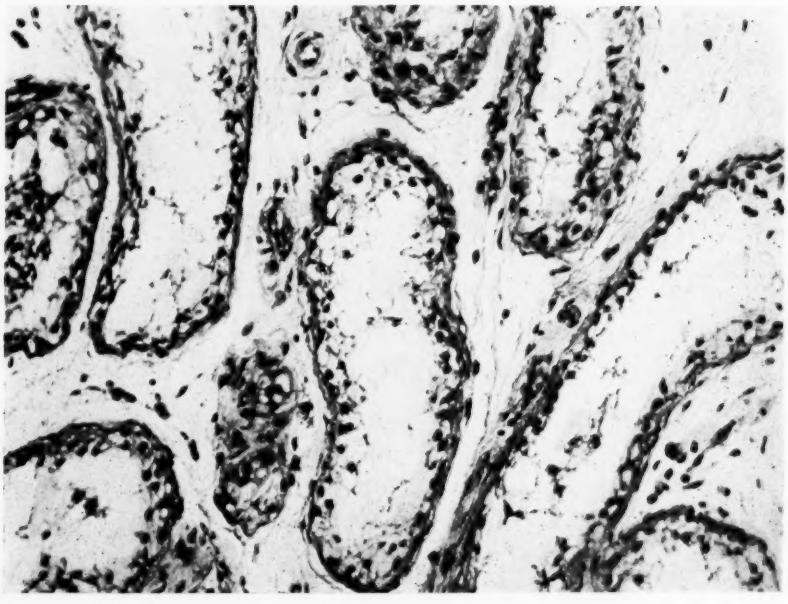


After Therapy

FIG. 1. H. B., age 78. Testosterone propionate 25 mg. given intramuscularly 7 times weekly for three months. Examination after therapy shows almost complete loss of germinal elements, no spermatozoa. Magnification 236 X.

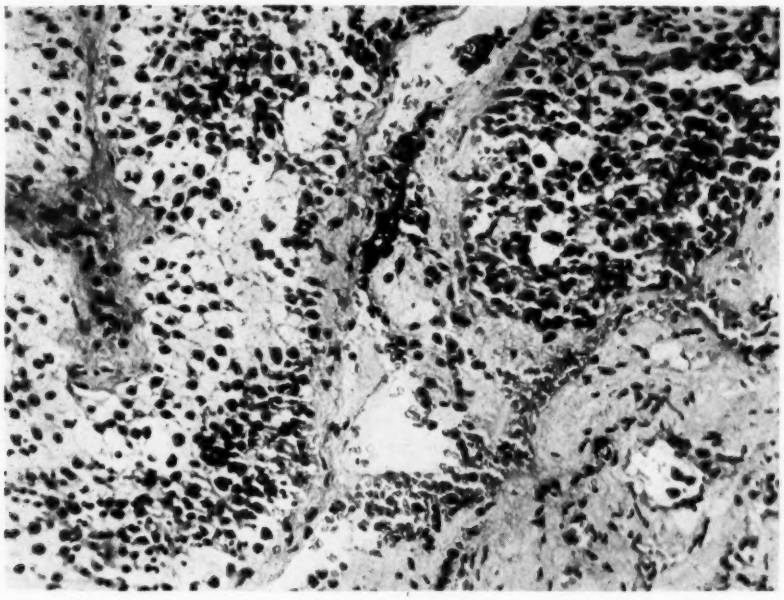


Before Therapy



After Therapy

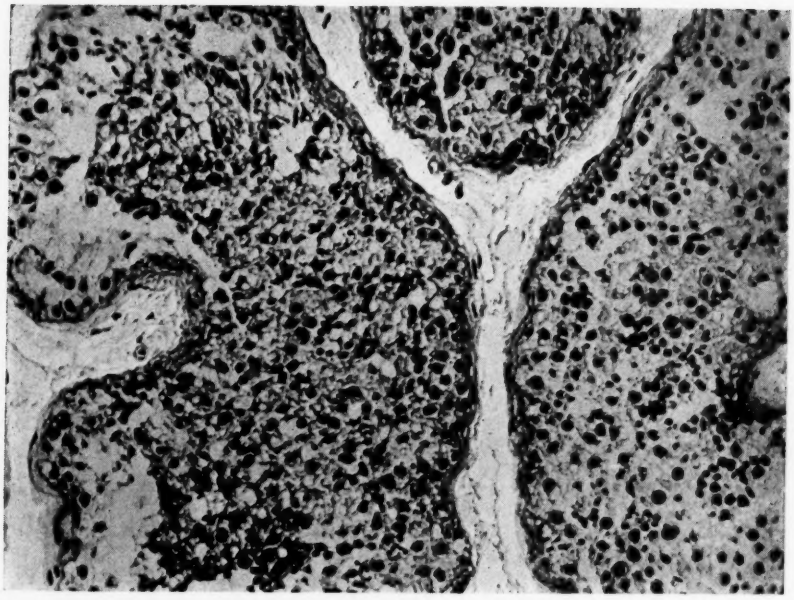
FIG. 2. M. S., age 85. Testosterone propionate 25 mg. given intramuscularly 5 times weekly for three months. Surprisingly little atrophy for age before therapy. Marked loss of germinal elements after therapy. Magnification 236 X.



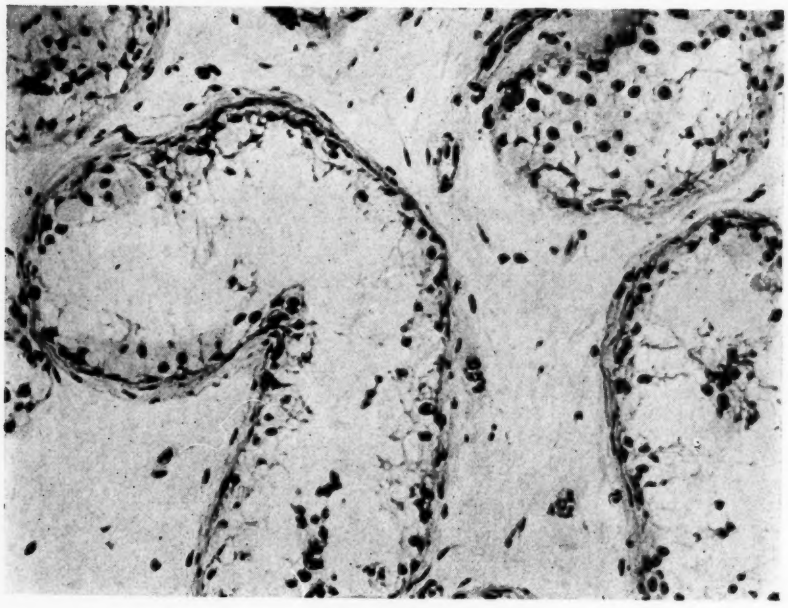
Before Therapy

After Therapy

FIG. 3. A. D., age 76. Testosterone propionate 25 mg. given intramuscularly 3 times weekly for three months. Considerable thickening of basement membrane, but fair preservation of activity by germinal elements before therapy. Complete loss of germinal epithelium with edema of intertubular spaces after therapy. Magnification 236 X.

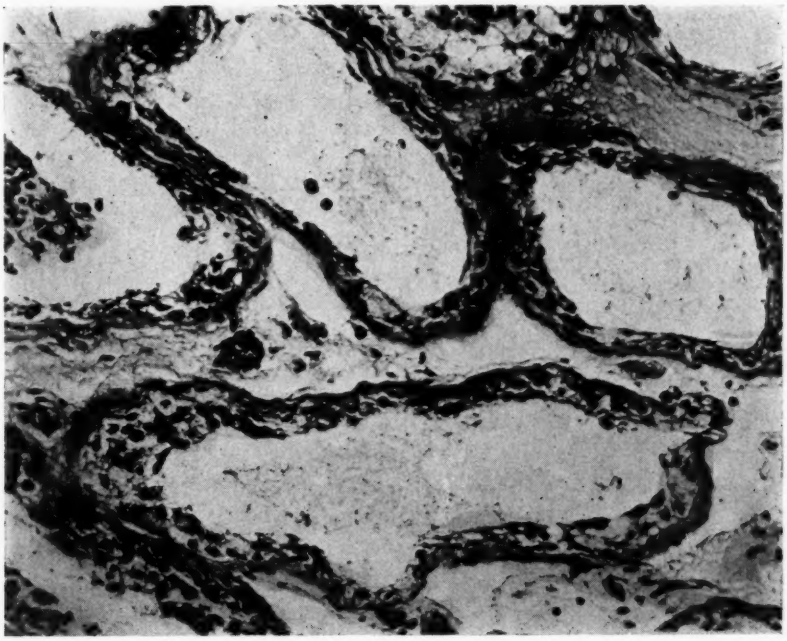


Before Therapy



After Therapy

FIG. 4. M. O., age 77. Testosterone propionate 25 mg. given intramuscularly 4 times weekly for three months. Some germinal elements are present in a few tubules after therapy, but there is a marked decrease in germinal activity. Magnification 236 X.



After Therapy

FIG. 5. H. C., age 72. Estrogen 6000 R. U. given intramuscularly 3 times weekly for three months. This section is presented to show similarity in microscopic changes in testicles of patients receiving estrogen and androgen therapy. Magnification 236 X.

climacteric. It was their belief that within ordinary physiologic limits testosterone had little effect on the pituitary elaboration of gonadotropins, but in doses exceeding physiologic amounts, suppression did take place.

Suppression of spermatogenesis, determined by observation of sperm count in men of all ages, has been reported by Heckel (6), Hotchkiss (8), McCullagh and McGurl (10, 11), Rubinstein and Kurland (15), and others. Rubinstein and Kurland (15) reported that in doses of 5 mg. 3 times weekly there was an increase in sperm count maintained throughout treatment, but that on increasing the dose to 25 mg. 3 times weekly, there was suppression in the output of spermatoza. None of the other workers substantiated this finding.

SUMMARY

Following the prolonged administration of testosterone propionate, testicular atrophy, characterized by marked decrease to complete loss of germinal elements, was found in a significant number of the total cases studied. Due to the profound structural changes presented by many of these patients, it is believed that the indiscriminate use of testosterone propionate should be avoided.

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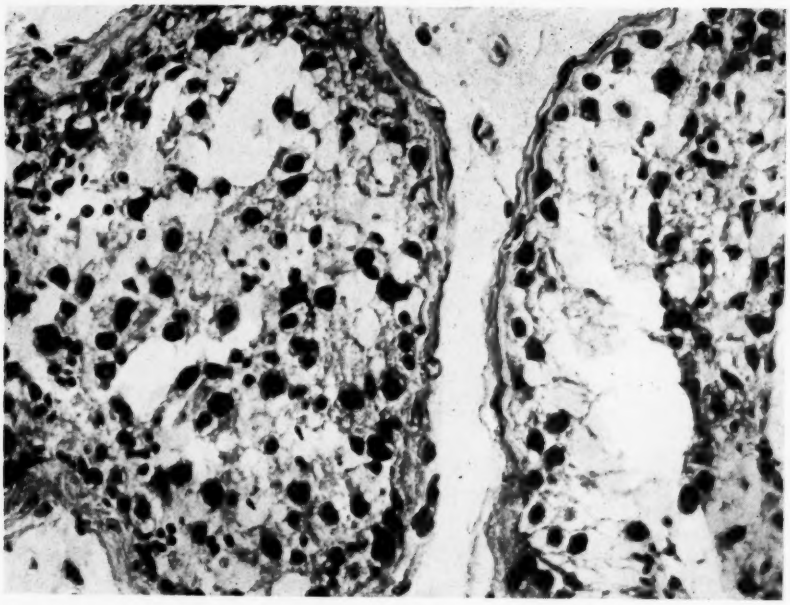
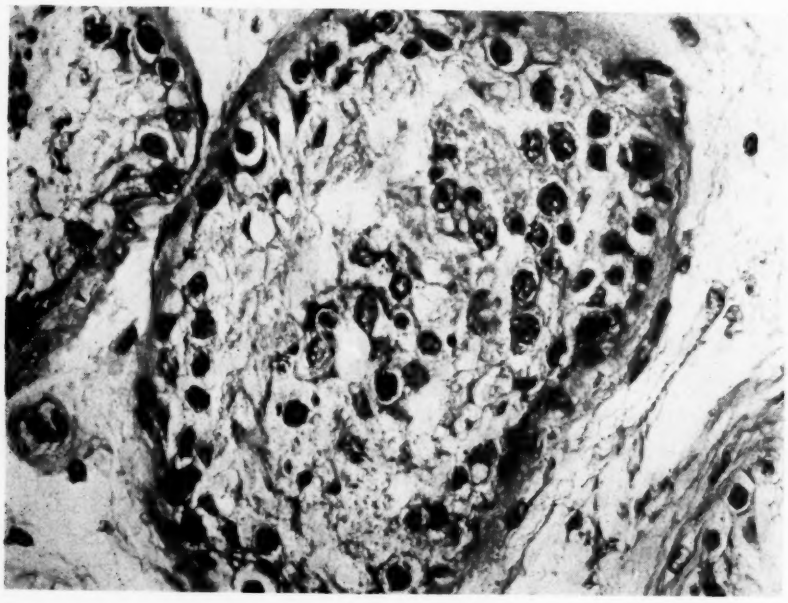


Before Therapy



After Therapy

FIG. 6. A. W., age 70. Chorionic gonadotropin 500 U. given intramuscularly 3 times weekly and testosterone propionate 25 mg. intramuscularly 5 times weekly for three months.

Does not show advanced loss of germinal elements as noted frequently with testosterone alone. Marked increase in mitotic activity but no adult spermatozoa present after therapy. Magnification 400 X.

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Aging in Apparently Normal Men.

IV. The Roentgenologic Appearance of the Thorax and Thoracic Organs

WALLACE S. TIRMAN AND JAMES B. HAMILTON

In 57 apparently normal men 21 to 75 years of age studies have been made of their endocrine status, as determined quantitatively by values for urinary ketosteroids, androgens, and gonadotrophins, and by measurements of certain secondary sex characters and other structures and functions under the influence of sex hormones. The value of this group of subjects, their selection, and the procedures employed to assure reliability of the measurements, are described elsewhere (4). In addition to these studies, other quantitative data pertaining to the effects of aging on the human body were also obtained with the expectation that they might be compared against the rather comprehensive endocrine background known for each individual or that these data might be useful in themselves with regard to delineation of the range of change and variability that accompanies aging. The group of individuals under study were inmates of a New York City prison. The rather extensive nature of this entire project arose from the fact that it was an unusual opportunity to study a comparable series of men who were living under a similar routine of life and were apparently normal rather than institutionalized for chronic illnesses.

This report is concerned with some of the quantitative changes that seem to take place with aging in the human thorax and certain thoracic organs, changes which are demonstrable by roentgenographic visualization and measurement. Studies utilizing x-rays were also made of other portions of the body in these same subjects, and may be reported on subsequently.

Materials and Methods

The films of the thorax were taken in postero-anterior and left anterior oblique positions at a distance of 190 cm. (6 feet), with an exposure of 1/10 of a second at 100 milliamperes. A lateral chest film, which included an esophagogram, was taken at a distance of 86.3 cm. (34 inches) with the subject recumbent. A Potter-Bucky diaphragm was used, with an exposure time of about one-fourth of a second.

Figure 1 illustrates the measurements employed in attempting to determine quantitatively some of the changes which accompany aging.

The methods employed in the determination of urinary ketosteroids are described in full elsewhere (4).

The sitting and standing heights, as determined according to standard anthropometric procedures (5), were measured when the subjects awakened in the morning and before they began to walk about.

The procedure used in determining specific gravity of the body was that described by Behnke and associates (1, 2), with the exception that we did not utilize an average figure for the amount of air in the lung but made actual measurements of the air with the use of hydrogen (9).

Variations from "normal." Although most of the individuals studied had what could be classified as healthy chests and none had emphysema demonstrable on x-ray films, some variations from what is considered as "normal" were found in the x-ray films of the chest:

1. Pulmonary calcification in 3 men. In case 28, age 45, calcified areas were present in the left apex. In case 43, age 55, bilateral pulmonary calcification was present in the upper lung fields. In case 45, age 58, calcification was present in the right lower lung field.

2. Foreign bodies in 2 men. Case 45, age 58, had a bullet in the left lung. Case 24, age 40, had a bullet in the right lung.

3. Pulmonary infiltration, compatible with tuberculosis, in 2 individuals. Case 46, age 59, had bilateral

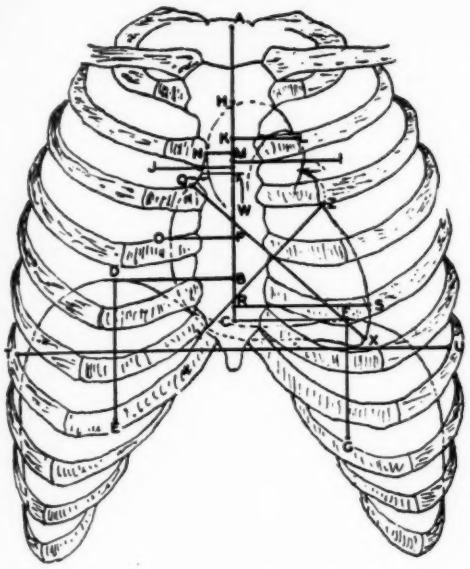

FIG. 1. Illustrates the measurements made of the x-ray films, taken under standardized procedures.

AB— Height of right hemithorax.
AC— Height of left hemithorax.
DE— Height of dome of right diaphragm.
FG— Height of dome of left diaphragm.
AI— Height of superior portion of mediastinum.
HI— Height of aorta, superior to hilum of left lung.
IJ— Height of left hilum superior to right hilum.
KL + MN—Maximum width of aorta.
OP + RS— Maximum diameter of heart.
TU— Maximum transverse diameter of interior of thorax.
HW— Height of aorta, superior to junction of aorta and heart.
QX— Long diameter of heart.
YZ— Broad diameter of heart.

extensive infiltration of the upper lung field, and case 51, age 63, had pulmonary infiltration and a calcified hilar gland, both on the right side.

4. Pleural thickening. Case 9, age 27, had pleural thickening on the left side with fusion of the 8th and 9th ribs. This may have been the result of an old empyema.

5. Scoliosis of the dorsal spine. Case 44, age 57.

If a systolic blood pressure over 150 mm. of mercury or a diastolic pressure over 90 is considered as the upper limits of normality, 7 of the 57 persons under study exceeded the normal range. The status of these individuals was as follows, as tested immediately upon arising in the morning:

Case No.	Age	Pressures, in Mm. of Mercury Systolic/Diastolic
30	46	121/92
47	60	116/94
49	60	162/71
53	65	152/85
54	68	200/61
56	72	168/108
57	75	164/71

INTERNAL HEIGHT OF THE THORAX

The following procedure was used in estimating the internal height of the thorax. The most superior portion of the lower border of the posterior part of the first rib was chosen as the superior limit of the thorax. In several kyphotic individuals the position of the second rib on the x-ray film was at a slightly higher level than the first rib; in these cases the uppermost rib was chosen as a landmark. A line was drawn connecting the superior limits of the thorax on the right and left sides. This was considered as the portion of the superior aperture of the thorax which would be the most easily identified and subject to the least distortion radiologically. A horizontal line was drawn through the midline of the thorax from the highest points of each lateral half of the diaphragm. The distance in the midline between the horizontal plane of the thoracic inlet and the level of the highest part of each lateral half of the diaphragm was employed as the vertical height for the right and left halves of the thorax. The average thoracic height in each individual was taken as the average of the right and left sides. All films were taken in deep inspiration.

Tables 1 and 2 list the changes with age in the height of the thorax.

(1) *Height of the thorax.* The height of both right and left sides increased slightly with age (table 1-A, B, C), significantly so on the right side by the sixth and seventh decades,

TABLE 1. AGE CHANGES OF THE VERTICAL HEIGHT OF THE THORAX.

	Age Group (Years)	No. of Men	Mean ± S. E. (Cm.)	S. D. (Cm.)	Significance of Difference from Average of 3rd Decade	
					t	P
A. Right Half	20–29	12	22.2±.37	1.28	—	—
	30–39	11	23.5±.66	2.19	1.757	.10
	40–49	12	23.2±.68	2.34	1.299	.25
	50–59	11	23.9±.62	2.05	2.415	.03
	60–75	10	24.1±.67	2.12	2.603	.02
B. Left Half	20–29	12	23.5±.43	1.50	—	—
	30–39	11	24.8±.78	2.58	1.494	.16
	40–49	12	24.7±.62	2.13	1.594	.13
	50–59	11	24.6±.70	2.32	1.361	.19
	60–75	10	25.6±.63	2.00	2.815	.01
C. Both Halves	20–29	12	22.9±.39	1.36	—	—
	30–39	11	24.2±.71	2.37	1.629	.12
	40–49	12	23.8±.63	2.19	1.208	.24
	50–59	11	24.3±.65	2.16	1.877	.08
	60–75	10	24.9±.63	1.99	2.789	.01

on the left side by the seventh decade. Some increase seemed to have occurred by the fourth decade with relatively little further change until the seventh decade.

There was no appreciable difference at any age in the vertical height of the right as compared with the left half of the thorax. Therefore, in comparisons of the vertical height of the thorax with other measurements, the average height of the two sides was used, rather than the height of the right or left half separately. Significant age changes in the vertical height of the thorax were found by the seventh decade.

(2) *Height of the thorax in relation to the width of the thorax.* The average internal transverse diameter of the thorax remained a constant figure that did not seem to vary appreciably with age or with sitting height. Therefore, the ratio of height of the thorax divided by width of the thorax changed with age only in so far as it reflected the increase with age in the height of the thorax. The ratio reached a maximum in the seventh decade (table 2-A).

(3) *Height of the thorax in relation to sitting height.* The sitting height decreased progressively with age, the decrease from values in the third decade becoming statistically significant by the seventh decade. The height of the thorax, in terms of its percentage of the sitting height, increased progressively in each decade and was statistically significant by the fifth decade (table 2-B). This expression of the height of the thorax in terms of percentage of the sitting height gives a more reliable index of the thoracic change with age than does the absolute values for intrathoracic height.

(4) *Height of the thorax in relation to standing height.* The standing height decreased with age. Changes with age in the values for standing height tended to be more obscured than similar changes in sitting height because of the great variability in length of the legs among different subjects. The height of the thorax as a percentage of the standing height increased progressively with age, the change becoming significant statistically by the sixth decade (table 2-C).

TABLE 2. AGE CHANGES OF THE VERTICAL HEIGHT OF THE THORAX, IN RELATION TO TRANSVERSE DIAMETER OF THORAX AND TO SITTING HEIGHT, STANDING HEIGHT, PONDERAL INDEX, AND SPECIFIC GRAVITY OF THE BODY.

	Age Group (Years)	No. of Men	Mean ± S.E. (%)	S.D. (%)	Significance of Difference from Average of 3rd Decade	
					t	P
A. Height of Thorax (Cm.)/ Transverse Diameter of Thorax (Cm.)	20-29	12	75.7 ± 1.61	5.57	—	—
	30-39	11	80.7 ± 3.46	11.47	1.346	.19
	40-49	12	81.9 ± 3.64	12.10	1.610	.13
	50-59	11	80.9 ± 2.84	9.44	1.626	.12
	60-75	10	84.4 ± 2.69	8.49	2.887	<.01
B. Height of Thorax (Cm.)/ Sitting Height (Cm.)	20-29	12	24.6 ± .35	1.21	—	—
	30-39	11	26.0 ± .69	2.29	1.849	.08
	40-49	12	26.2 ± .62	2.14	2.254	.04
	50-59	11	26.9 ± .56	1.86	3.538	<.01
	60-75	10	27.8 ± .56	1.76	5.024	<.01
C. Height of Thorax (Cm.)/ Standing Height (Cm.)	20-29	12	13.3 ± .21	.74	—	—
	30-39	11	14.0 ± .33	1.10	1.809	.09
	40-49	11	14.1 ± .40	1.34	1.786	.09
	50-59	11	14.2 ± .31	1.04	2.400	.03
	60-75	10	14.6 ± .29	.92	3.662	<.01
D. Height of Thorax (Cm.)/ Ponderal Index	20-29	12	54.6 ± .70	2.43	—	—
	30-39	11	56.6 ± 1.10	3.64	1.561	.14
	40-49	11	55.9 ± 1.32	4.28	.906	.38
	50-59	11	57.1 ± 1.12	3.73	1.919	.07
	60-75	10	57.9 ± 1.46	4.62	2.017	.06
E. Height of Thorax (Cm.)/ Specific Gravity of Body	20-29	10	21.6 ± .38	1.21	—	—
	30-39	9	22.4 ± .72	2.17	1.003	.33
	40-49	6	23.4 ± .97	2.38	2.018	.07
	50-59	6	23.5 ± .84	2.06	2.343	.03
	60-75	5	23.7 ± 1.00	2.25	2.384	.03

(5) *Height of the thorax in relation to values for standing height/$\sqrt[3]{\text{body weight}}$.* According to some anthropologists (7), the external measurements of the body bear a relationship to the ratio of standing height/$\sqrt[3]{\text{body weight}}$. This ration, which is known as the "ponderal index," does not change significantly with age.

The vertical height of the thorax, expressed as a percentage of this figure in table 2-D, did not change significantly with age.

(6) *Height of the thorax in relation to specific gravity of the body.* The specific gravity decreased progressively until the seventh decade whereupon the values seemed to increase slightly.

The change with age in values for height of the thorax / specific gravity of the body became significant by the sixth decade (table 2-E).

MAXIMUM TRANSVERSE DIAMETER OF INTERIOR OF THORAX

These values apply to the greatest transverse diameter of the thorax as measured from the internal surfaces of the ribs on right and left

TABLE 3. AGE CHANGES OF LINEAR DIMENSIONS OF THE THORAX AND THORACIC VISCERA.

	Age Group (Years)	No. of Men	Mean ± S.E. (Cm.)	S.D. (Cm.)	Significance of Difference from Average of 3rd Decade	
					t	P
A. Maximal Transverse Diameter of Interior of Thorax.	20-29	12	30.1 ± .43	1.43	—	—
	30-39	11	30.2 ± .72	2.38	.123	>.50
	40-49	12	29.3 ± .77	2.68	.929	.36
	50-59	11	30.2 ± .76	2.52	.118	>.50
	60-75	11	29.6 ± .53	1.76	.751	.46
B. Relative Height of Left Hilum Above Right Hilum.	20-29	12	0.8 ± .14	.49	—	—
	30-39	11	0.9 ± .08	.28	.595	>.50
	40-49	12	1.0 ± .13	.46	1.036	.31
	50-59	10	1.1 ± .19	.59	1.310	.21
	60-75	10	0.8 ± .11	.36	0	1.00
C. Length of Superior Portion of Mediastinum.	20-29	12	10.0 ± .20	.68	—	—
	30-39	11	10.7 ± .28	.93	2.077	.05
	40-49	12	10.7 ± .25	.85	2.222	.04
	50-59	11	11.0 ± .32	1.05	2.732	.01
	60-75	10	11.8 ± .25	.80	5.714	<.01
D. Maximal Antero-Posterior Diameter of Interior of Thorax.	20-29	7	14.4 ± .28	.75	—	—
	30-39	7	16.2 ± .68	1.80	2.446	.03
	40-49	7	15.6 ± .58	1.53	1.722	.11
	50-59	9	17.1 ± .77	2.30	2.961	.01
	60-75	10	17.3 ± .66	2.07	3.524	<.01
E. Height of Aorta Superior to Cardio-Aortic Junction.	20-29	12	7.9 ± .24	.84	—	—
	30-39	11	8.9 ± .29	.97	2.646	.02
	40-49	8	8.5 ± .41	1.15	1.348	.20
	50-59	10	9.2 ± .37	1.16	3.044	<.01
	60-75	9	10.0 ± .62	1.85	3.494	<.01
F. Height of Aorta, Above Left Hilum.	20-29	12	3.5 ± .12	.42	—	—
	30-39	11	4.2 ± .19	.63	3.153	<.01
	40-49	11	3.9 ± .21	.70	1.681	.11
	50-59	11	4.1 ± .15	.50	3.109	<.01
	60-75	11	5.0 ± .20	.65	6.637	<.01
G. Maximal Width of Aortic Arch.	20-29	12	5.3 ± .13	.46	—	—
	30-39	11	5.8 ± .20	.66	2.110	.05
	40-49	10	5.8 ± .21	.66	2.083	.05
	50-59	11	6.4 ± .25	.82	4.000	<.01
	60-75	10	6.7 ± .36	1.14	3.889	<.01
H. Maximal Transverse Diameter of Heart.	20-29	12	12.9 ± .30	1.04	—	—
	30-39	11	12.8 ± .44	1.47	.189	>.50
	40-49	12	12.3 ± .40	1.40	1.188	.25
	50-59	11	13.2 ± .39	1.29	.615	>.50
	60-75	11	13.8 ± .48	1.60	1.610	.13

sides superior to the costal attachment of the diaphragm.

There was no significant change in these values with age (table 3-A).

TABLE 4. EXTENT TO WHICH THE HORIZONTAL PLANE OF THE HILUM OF THE LEFT LUNG EXCEEDS THAT OF THE HILUM OF THE RIGHT LUNG.

Greater Height of Left Than Right Hilum (Cm.)	Subjects	
	Number	Percentage
0.1-0.3	4	7
0.4-0.6	10	18
0.7-0.9	16	29
1.0-1.2	13	24
1.3-1.5	7	13
1.6-1.9	4	7
Over 1.9	1	2

POSITION OF THE SHADOWS CAST BY HILA OF THE LUNGS

Changes in the location of shadows of the hila were considered to be an important correlate of aging in the upper mediastinum, because the hila are reliable landmarks against which measurements can be taken of the amount of stretching in the upper mediastinum. It may be recalled that the position of the hila relative to one another are an aid in the diagnosis of lobar and segmental collapse of the lung (6).

The landmark chosen in both shadows was the superior-most portion of the pulmonary artery. This could be identified readily and more accurately than bronchi, for example. The hilar shadows were clearly visualized in 55 of the 57 subjects.

(1) *Position of right and left hila relative to one another.* The left hilum was superior to the right in all subjects. Table 4 indicates that in more than 50 per cent of the patients the left hilum was 0.7 to 1.2 cm. above the right. In less than one-sixth of the group of men was the distance less than 0.4 cm. or greater than 1.5 cm.

The greatest distance by which the left hilar shadow was elevated above the right in any individual was 2.3 cm.. a condition present in a subject with pronounced dorsal scoliosis. Excluding this case, the greatest height of the left hilum above the right was 1.9 cm. in a subject 49 years of age; the x-ray film of this patient was that of an essentially healthy chest and the hilar shadows were not difficult to outline. Of the 4 men in whom the left hilum was 1.5 to 1.9 cm. above the right, one, age 55, had pulmonary calcification. There was no elevation of blood pressure in these 4 individuals. It would seem, therefore, that the upper limits of normal as regards the height of the left hilum above the right is about 1.9 cm.

The smallest difference between the hilar shadows was 0.1 cm. and there seemed to be no minimal difference beyond which the status is abnormal.

The heights of the left and right hila, relative to one another, did not change with age (table 3-B).

(2) *Level of hilar shadows with reference to the bony thorax.* It was considered desirable to determine the location of the hilar shadows within the thorax. The distance between the left hilum and the thoracic inlet increased progressively and significantly with age (table 3-C). Statistically significant changes had occurred by the fifth decade.

Undoubtedly the increase in height of the superior portion of the mediastinum was due in small part to a general increase in thoracic height. But it was not due entirely to this factor as shown by the fact that the increase in the ratio of $\frac{\text{length of the superior mediastinum}}{\text{height of thorax}}$ changed significantly by the seventh decade (table 5-A).

Our data do not bear upon the possibility that the increase in length of the upper mediastinum arises in part from the loss of elasticity and stretching of the vascular elements and probably also from similar changes in the other mediastinal structures, especially the trachea and bronchi.

(3) *Level of hilar shadows in relation to changes in sitting height.* The distance from

TABLE 5. AGE CHANGES OF THE LENGTH OF THE SUPERIOR MEDIASTINUM, IN RELATION TO HEIGHT OF THE THORAX, SITTING HEIGHT, AND STANDING HEIGHT.

	Age Group (Years)	No. of Men	Mean ± S.E. (%)	S.D. (%)	Significance of Difference from Average of 3rd Decade	
					t	P
A. Length of Superior Mediastinum (Cm.)/ Height of Thorax (Cm.)	20-29	12	43.8 ± .71	2.46	—	—
	30-39	11	44.2 ± .64	2.14	.414	>.50
	40-49	12	45.2 ± 1.01	3.50	1.133	.27
	50-59	11	45.2 ± 1.02	3.39	1.141	.27
	60-75	10	47.4 ± 1.13	3.57	2.791	.01
B. Length of Superior Mediastinum (Cm.)/ Sitting Height (Cm.)	20-29	12	10.7 ± .16	.55	—	—
	30-39	11	11.4 ± .25	.84	2.381	.03
	40-49	12	11.8 ± .24	.84	3.780	<.01
	50-59	11	12.2 ± .33	1.09	4.213	<.01
	60-75	10	13.1 ± .22	.70	9.023	<.01
C. Length of Superior Mediastinum (Cm.)/ Standing Height (Cm.)	20-29	12	5.8 ± .08	.28	—	—
	30-39	11	6.2 ± .13	.43	2.632	.02
	40-49	11	6.3 ± .14	.48	3.067	<.01
	50-59	11	6.4 ± .18	.59	3.141	<.01
	60-75	10	6.9 ± .10	.33	8.333	<.01

the thoracic inlet to the left hilum became a greater percentage of the sitting and standing heights in each successive decade (tables 5-B and 5-C), as would be expected from the elongation of the superior portion of the mediastinum and shortening of the trunk of the body.

MAXIMAL ANTERO-POSTERIOR DIAMETER OF THE THORAX

Lateral films of the chest which were taken at a distance of 86.3 cm. undoubtedly showed more distortion than those taken at 190 cm. in the postero-anterior position. The error was probably more or less of a constant one, however, and no corrections were made for it. The lateral films were unsatisfactory in 17 subjects, chiefly as a result of an accident in the processing of the films. The antero-posterior diameter was measured in a horizontal plane from the posterior surface of the sternum to the anterior surface of the vertebral column. The largest diameter above the inferior-most level of the costophrenic sulcus was considered as the maximum antero-posterior diameter of the thorax.

There was considerable variability in the absolute averages per decade (table 3-D). The antero-posterior diameter increased progressively with age. It was statistically significant by the fourth decade and with one exception continued to be so through the seventh decade.

The increase in averages was more progressively consistent when considered in relation to the sitting height or to the standing height, an observation which may also reflect other changes that occur in the thoracic cage (table 6-A, B).

Again it is seen that the diameters of the thorax when related to the sitting height give a clearer picture of the actual relative change in the size of the thorax.

DIAPHRAGM

The height of the right and left halves of the dome of the diaphragm was determined by measuring the vertical distance between the

level of each dome and the level of the corresponding lateral costophrenic sinus on the postero-anterior film. This film was taken in deep inspiration.

The height of both the right and left halves of the dome of the diaphragm decreased materially with age (table 7-A, B). A significant decrease in the height (flattening) was noted

TABLE 6. AGE CHANGES OF THE MAXIMUM INTERNAL (ANTERIOR-POSTERIOR) DIAMETER OF THE THORAX, IN RELATION TO SITTING HEIGHT AND STANDING HEIGHT.

	Age Group (Years)	No. of Men	Mean ± S.E. (%)	S.D. (%)	Significance of Difference from Average of 3rd Decade	
					t	P
A. Maximum Internal (AP) Diameter of Thorax (Cm.)/ Sitting Height (Cm.)	20-29	7	15.6 ± .22	.59	—	—
	30-39	7	17.1 ± .76	2.01	1.896	.09
	40-49	7	17.4 ± .66	1.74	2.594	.03
	50-59	9	18.9 ± .84	2.59	3.284	<.01
	60-75	10	19.4 ± .73	2.30	4.236	<.01
B. Maximum Internal (AP) Diameter of Thorax (Cm.)/ Standing Height (Cm.)	20-29	7	8.4 ± .14	.38	—	—
	30-39	7	9.2 ± .41	1.09	1.831	.10
	40-49	7	9.3 ± .38	1.01	2.200	.05
	50-59	9	10.0 ± .46	1.38	2.952	.01
	60-75	10	10.2 ± .38	1.19	3.846	<.01

TABLE 7. AGE CHANGES OF THE DOMES OF THE DIAPHRAGMS, IN TERMS OF THE VERTICAL DISTANCE OF EACH DOME FROM THE CORRESPONDING COSTOPHRENIC SINUS, AND CHANGES WITH AGE IN HEIGHT BETWEEN THE RIGHT AND LEFT DOMES.

	Age Group (Years)	No. of Men	Mean ± S.E. (Cm.)	S.D. (Cm.)	Significance of Difference from Average of 3rd Decade	
					t	P
A. Right Dome.	20-29	12	5.9 ± .32	1.09	—	—
	30-39	11	5.2 ± .58	1.93	1.084	.29
	40-49	12	4.8 ± .38	1.32	2.222	.04
	50-59	11	4.4 ± .47	1.55	2.703	.01
	60-75	11	4.8 ± .41	1.36	2.148	.045
B. Left Dome.	20-29	12	4.9 ± .35	1.22	—	—
	30-39	11	4.2 ± .39	1.28	1.346	.19
	40-49	12	4.1 ± .30	1.03	1.739	.10
	50-59	11	3.8 ± .34	1.14	2.236	.04
	60-75	11	3.5 ± .36	1.20	2.783	.01
C. Excess in Height of Right Dome over Left Dome.	20-29	12	1.0 ± .27	.93	—	—
	30-39	11	1.0 ± .33	1.11	0	1.00
	40-49	12	0.8 ± .43	1.48	.396	>.50
	50-59	11	0.6 ± .36	1.20	.897	.38
	60-75	11	1.3 ± .40	1.34	.626	>.50

on the right side by the fifth decade and on the left side by the sixth decade. These changes persisted in the subsequent decades.

Relative to one another, the height of the two halves of the diaphragm did not change progressively with age (table 7-C).

In the majority of the subjects the height of the right side of the diaphragm exceeded that of the left. The left diaphragm had a greater height than the right in only 7 of the men. They were, respectively, 29, 38, 40, 45, 57, 58, and 65 years of age. Of these only the 2 youngest had films indicating that the chest should be considered as "healthy." The other 5 men presented some abnormality: 2, age 40 and 58, had foreign bodies in the lung (bullets); 1, age 45, had pulmonary calcification; 1, age 57, had a dorsal scoliosis; and 1, age 65, had a blood pressure slightly above normal, 151/85. In 1 man, age 47 and apparently healthy, the height of the dome of the diaphragm was similar on both sides. In those individuals in whom the right diaphragmatic dome presented a greater height, the average of the difference in height of the 2 diaphragmatic domes was as follows:

Age	Difference in Heights Right Higher than Left (Cm.)
20-29	1.2
30-39	1.23
40-49	1.4
50-59	1.0
60-68	0.9
70-75	2.5

Thus, in 55 individuals, the left dome was of greater height than the right in only 2 cases (3.5 per cent) in whom the chest could be classified as healthy judging from the x-ray. It might be concluded that in healthy chests it is most unusual for the dome of the left diaphragm to present a greater height above the lateral costophrenic sinus than the right above its corresponding costophrenic sinus.

Aorta

The extent to which the aorta elongates may be an index of the effects of aging upon the large vessels of the arterial system. It was believed that the vertical height of the aorta above some fixed level near its origin might be a valuable index of the degree of elongation. The landmark near the level of the origin of the aorta which could be identified most easily was the left hilar shadow. A line was drawn horizontally from the superior-most surface of the aorta to intersect the midsagittal plane of the thorax on the postero-anterior film. Another horizontal line was drawn from the superior-most surface of the pulmonary artery at the left hilum to reach the mid-sagittal plane. The distance between the two intersections was then measured. In 1 individual the measurement could not be made satisfactorily.

*It should be recognized that the left hilar shadow, which was used as a landmark, comes with age to be located farther inferiorly, as measured with the thoracic inlet as the frame of reference (table 3-C). This distance between the hilar shadow and the thoracic inlet shared in the elongation of the aging thorax and until the seventh decade did not appreciably exceed the difference that might be accounted for simply by elongation of the thorax (table 5-A). It is noteworthy, therefore, that the increased height of the aorta with age continued to be evident even after allowance had been made for elongation of the thorax (table 8-A). Hence, the greater height of the aging aorta exceeded any change that might originate from displacement inferiorly of the left hilar shadow. This is also shown in table 3-E in which the height of the aorta, as measured in these same x-ray films but with the use of the actual cardio-aortic junction as a frame of reference indicates similarly that an elongation

* An attempt was made to measure the distance between the anterior aspect of the ascending aorta and the posterior of the descending aorta, also considered to be important, but was found not to be satisfactory. Similarly the amount of dilatation of the aorta could not be clearly determined without the use of contrast media.

TABLE 8. AGE CHANGES OF THE HEIGHT OF THE AORTA, IN RELATION TO HEIGHT OF THE THORAX AND SITTING HEIGHT.

	Age Group (Years)	No. of Men	Mean ± S.E. (%)	S.D. (%)	Significance of Difference from Average of 3rd Decade	
					t	P
A. Height of Aorta, Above Left Hilum (Cm.)/ Height of Thorax (Cm.)	20-29	12	15.3 ± .66	2.28	—	—
	30-39	11	17.1 ± .45	1.51	2.211	.04
	40-49	11	16.2 ± .88	2.91	.829	.42
	50-59	11	17.0 ± .58	1.93	1.919	.07
	60-75	10	19.8 ± .85	2.69	4.253	<.01
B. Height of Aorta, Above Left Hilum (Cm.)/ Sitting Height (Cm.)	20-29	12	3.7 ± .15	.52	—	—
	30-39	11	4.4 ± .17	.58	3.043	<.01
	40-49	11	4.3 ± .22	.74	2.264	.04
	50-59	11	4.6 ± .16	.53	4.091	<.01
	60-75	11	5.6 ± .19	.64	7.787	<.01
C. Height of Aorta, Above Cardio-Aortic Junction (Cm.)/ Height of Thorax (Cm.)	20-29	12	34.7 ± 1.07	3.70	—	—
	30-39	11	36.9 ± .84	2.77	1.601	.13
	40-49	8	35.4 ± 1.69	4.79	.369	>.50
	50-59	10	37.9 ± 1.26	3.98	1.951	.07
	60-75	8	39.0 ± 2.54	7.19	1.764	.10

occurred with age. Measurements made at autopsy by other investigators show that with age there is a loss of elasticity in the aorta (3).

(1) *Height of the aorta superior to the left hilum.*

Table 3-F shows that the length of the portion of the aorta under study increased by the fourth decade, remained relatively stationary between the fourth and sixth decades, after which the aorta elongated still further.

It would seem that the probable upper limit of normal of this measurement for men less than 60 years of age is about 5.0 cm.

All of the 11 individuals over the age of 60 had measurements of 4.0 cm. or greater. In only 1 man was the height of the aorta less than 4.4 cm. Shown in table 9 is the distribution in the group, with a notation as to the 6 men in whom blood pressures were elevated.

The list in table 9 included all but 1 of the men who had high blood pressures. In that individual, age 46, the measurement was 4.1 cm. and blood presure was 121/92. One cannot conclude, however, that in subjects who have an elevated blood pressure, the height of the aortic arch over the left hilar shadow is

TABLE 9. HEIGHT OF THE AORTA (CM. ABOVE LEFT HILUM) IN ALL SUBJECTS WHO WERE 60 OR MORE YEARS OF AGE. VALUES FOR BLOOD PRESSURES ARE LISTED IN SUBJECTS IN WHOM THE READINGS EXCEED THE NORMAL RANGE.

Age in Years	Height of Aorta (Cm.)	Systolic/Diastolic (Mm. of Mercury)
60	4.0	In normal range
60	5.2	116/94
60	5.6	162/71
62	4.6	In normal range
63	4.5	In normal range
65	4.7	In normal range
65	6.1	152/85
68	4.4	200/61
70	5.5	In normal range
72	5.5	168/108
75	4.5	164/71

necessarily greater than in individuals without elevated blood pressure. Of the cases listed in table 9, the average height of the aorta was 5.22 ± .185 in the 6 men with high pressures and 4.66 ± .146 in the 5 men with normal pressures; these values, although somewhat greater in men with high pressures, were not great enough to be statistically significant.

(2) *Elongation of the aorta in relation to changes in sitting height.* Table 8-A shows that the increase of the height of the aorta, expressed as a percentage of the sitting height (table 8-B), shows an increase similar to that evident in the absolute figures for the changing height of the aorta. There is somewhat of a plateau from age 30 to age 59, followed by a rather sharp increase after 60 years of age. This would indicate that the aorta begins to stretch most markedly after the age of 60 but that the process is more or less a continuous one that was displayed as early as the fourth decade. The same trends are evident in individuals with and without an elevated blood pressure.

(3) *Elongation of the aorta above the left hilum in relation to increase in height of the thorax.* Between the third and seventh decades the average increase was 1.5 cm. for the length of the aorta, 2.0 cm. for the length of the thorax. Changes with age in the ratio of these 2 items are listed, respectively, in tables 3-F and 1-C. Table 8-A presents the age changes in height of the aortic arch above the left hilum in relation to the height of the thorax. This ratio shows an early significant increase from the third to the fourth decades, followed by a decrease, with a gradual increase again to become significant in the seventh decade and to remain so thereafter.

(4) *Maximal width of the aortic arch.* The sum of the greatest deviation of the aorta from the midline on both the right and the left sides has been used frequently as an index of the amount of elongation of the aorta. Table 3-G shows an increase with age that is statistically significant by the fourth decade and even greater by the sixth decade.

(5) *Elongation of the aorta superior to its junction with the heart.* The cardio-aortic junction was sufficiently sharp to be identified in 50 of the subjects. From this point a line was projected horizontally to the midline, and the distance was measured vertically to the level of the superior aspect of the aortic arch. This distance indicated again that the aorta elongated by the fourth decade and appreciably so after the fifth decade. In general these changes are significant statistically (table 3-E). The height of the aorta with reference to the thoracic height also increases with age but not to a significant extent in most decades (table 8-C).

Thus the height of the aorta, as measured either in terms of the distance from the cardio-aortic junction or from the left hilar shadow, increased progressively with age. It should be noted that the elongation was less in the measurements between 2 sites on the aorta itself than in the distance between the aortic arch and the hilum; in all likelihood the values in terms of distance from the hilar shadow overemphasized the degree of elongation of the aorta due to displacement of the hilar shadow inferiorly.

The average values for the length of the aorta in men 60 or more years of age was 9.78 ± .541 in 4 men with normal blood pressures and 10.22 ± .550 in 5 men with elevated blood pressures. The difference between these 2 groups is not enough to be statistically significant.

Heart

(1) *Maximal transverse diameter of the heart.* This was measured in terms of the sum of the greatest deviation from the midline on the right and left sides. Table 3-H shows very little change in the average maximal transverse diameter of the heart except for the few cases in the eighth decade, all of whom had elevated blood pressures. This lack of increase with age is in contrast with the rule observed in all of the thoracic viscera described above with the exception of the maximal internal diameter of the thorax. But this suggests that the increase in size of the heart, as

indicated by the maximal transverse diameter, may be an aging feature which is late in appearing to a significant extent.

(2) *Maximal transverse diameter of the heart in terms of the maximal transverse diameter of the thorax.* The average values for the maximal transverse diameter of both the heart and thorax remained essentially stationary with increasing age (table 10). It is interesting that in only 3 of the 57 individuals did the maximum transverse diameter of the heart occupy more than 50 per cent of the maximum transverse internal diameter of the thorax and that these 3 had elevated blood pressures.

TABLE 10. AGE CHANGES OF THE TRANSVERSE DIAMETER OF THE HEART, IN RELATION TO THE TRANSVERSE DIAMETER OF THE THORAX.

Age Group (Years)	No. of Men	Mean ± S.E. (%)	S.D. (%)	Significance of Difference from Average to 3rd Decade	
				t	P
20-29	12	42.9 ± .95	3.28	—	—
30-39	11	42.4 ± 1.29	4.30	.317	>.50
40-49	12	42.2 ± 1.68	5.80	.365	>.50
50-59	11	43.7 ± .91	3.02	.612	>.50
60-75	11	46.6 ± 1.88	6.23	1.810	.09

(3) *Actual heart area.* The actual area of the heart was calculated from the long and broad diameters by the method of Ungerleider and Gubner (8). There was a gradual increase in the heart area with age (table 11). This figure became statistically significant by the seventh decade, and remained significant in the eighth decade.

TABLE 11. AGE CHANGES OF THE SIZE (AREA) OF THE HEART.

Age Group (Years)	No. of Men	Mean ± S.E. ($Cm.^2$)	S.D. ($Cm.^2$)	Significance of Difference from Average of 3rd Decade	
				t	P
20-29	12	126 ± 4.7	16.1	—	—
30-39	11	130 ± 5.1	17.0	.580	>.50
40-49	12	128 ± 2.8	9.9	.367	>.50
50-59	11	133 ± 7.0	23.4	.843	.40
60-75	10	147 ± 5.8	18.4	2.862	<.01

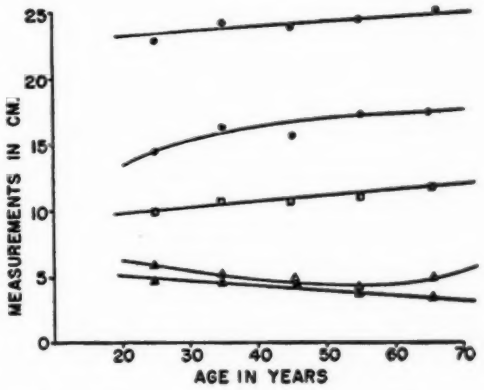

FIG. 2. Age curves of linear dimensions of the thorax.
○ Vertical height of thorax.
● Maximal internal (AP) diameter of thorax.
□ Length of superior portion of mediastinum.
△ Height of right dome of diaphragm.
▲ Height of left dome of diaphragm.

DISCUSSION

Changes with age in the dimensions of the thorax and certain of its viscera as demonstrated roentgenographically are illustrated in Figs. 2 to 6. These alterations fall into 2 groups which may be summarized according to decades of life.

1. Factors which influence intra-thoracic volume. With values for the sitting height as a frame of reference, the maximal anteroposterior diameter and the vertical height of the thorax increase decade by decade. In the present series of cases the maximal increase is present in the seventh decade. The changes are more prominent in the maximal anteroposterior depth than in the height of the thorax.

The maximal transverse internal diameter of the thorax remains practically the same when the average for each decade is considered

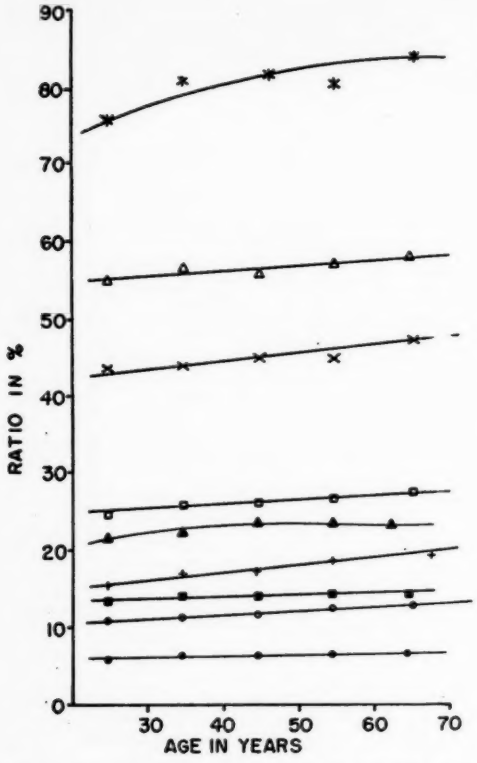

FIG. 3. Age curves of ratios of thoracic and body measurements.

○ $\frac{\text{Length of superior portion of mediastinum}}{\text{Sitting height}}$

● $\frac{\text{Length of superior portion of mediastinum}}{\text{Standing height}}$

□ $\frac{\text{Height of thorax}}{\text{Sitting height}}$

▪ $\frac{\text{Height of thorax}}{\text{Standing height}}$

△ $\frac{\text{Height of thorax}}{\text{Standing height} / \sqrt[3]{\text{Body weight}}}$

▲ $\frac{\text{Height of thorax}}{\text{Specific gravity}}$

+ $\frac{\text{Maximal internal (AP) diameter of thorax}}{\text{Sitting height}}$

× $\frac{\text{Length of superior portion of mediastinum}}{\text{Height of thorax}}$

* $\frac{\text{Height of thorax}}{\text{Transverse diameter of thorax}}$

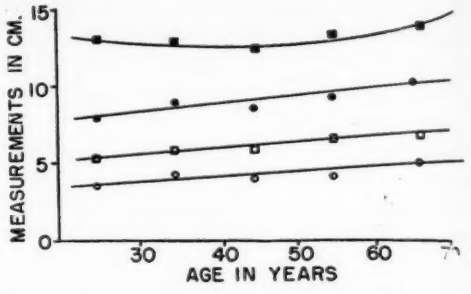

FIG. 4. Age curves of linear dimensions of heart and intra-thoracic vascular structures.

○ Height of aortic arch, above left hilum.

● Height of aortic arch, above cardio-aortic junction.

□ Width of aortic arch.

▪ Transverse diameter of heart.

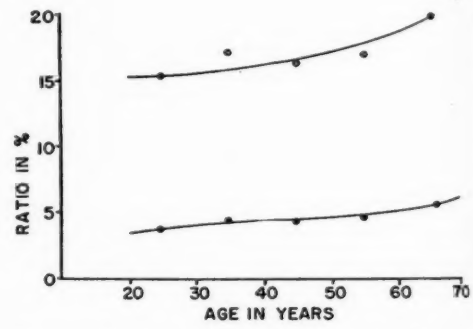

FIG. 5. Age curves of ratios of height of aortic arch to height of thorax and sitting height.

○ $\frac{\text{Height of aortic arch above left hilum}}{\text{Height of thorax}}$

● $\frac{\text{Height of aortic arch above left hilum}}{\text{Sitting height}}$

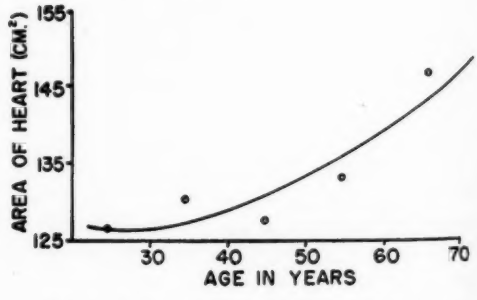

FIG. 6. Age curve of size (area) of heart.

either as an absolute figure or as a percentage of the sitting height. This suggests that in older men the thorax does not tend to assume a more inspiratory position with regard to the location of the lower ribs, although it does so with regard to other dimensions of the thorax.

On both the right and left sides the dome of the diaphragm becomes progressively flatter in each decade.

2. The thoracic viscera. The portion of the mediastinum superior to the level of the hilum of the left lung shows a progressive increase in length with each decade. This change seems to be independent of, and relatively greater than, the increase in height of the thorax.

The aorta elongates progressively with passing decades, as demonstrated in several ways, the most reliable of which seems to be in the length of the aorta superior to the level of the left pulmonary artery. Elongation of the aorta is also independent of the changes in the height of the thorax.

Measurements of the transverse diameter of the heart showed very little variation with age, either as absolute figures or as a percentage of the maximum internal diameter of the thorax. Neither an increase or decrease was noted in subjects who did not have notable elevation of blood pressure.

The relationship between the levels of the 2 hila of the lungs is a definite one and does not change with age. In all subjects the left pulmonary artery was at a higher level than the right.

The actual area of the heart shows an increase with age.

There are no significant correlations between the urinary excretion of 17-ketosteroids in these men and any of these thoracic features, whether linear measurements, ratios, or measures of area. The Pearson product-moment coefficients of correlation are of the order of 0.2, with probable errors of the order of 0.1. The age trends of the group averages for most of the thoracic measurements and for the urinary 17-ketosteroids are unmistakable, although unrelated, in the sense that there are no correlations in values for all individuals.

A similar lack of correlation exists between the quantity of axillary hair and these thoracic features.

Summary

As studied in a group of 57 individuals, the influence of the aging process upon the dimensions of the thorax, the diaphragm, and the thoracic viscera as demonstrated roentgenographically were observed to be as follows:

From the third decade to and including the seventh decade, the changes in the thoracic cage and thoracic viscera subsequent to age follow the same patterns.

No correlation was found between values for thoracic measurements and quantitative indices of endocrine status as reflected in the excretion of urinary ketosteroids and the mass of axillary hair, a secondary sex character.

Age curves have been drawn for each of the thoracic features which show statistically significant differences between the youngest age group (21 to 29 years) and succeeding decades. These features are:

Vertical height of thorax
A-P diameter of thorax
Length of superior portion of mediastinum
Height of right dome of diaphragm
Height of left dome of diaphragm
Transverse diameter of heart
Height of aortic arch above cardio-aortic junction
Width of aortic arch
Height of aortic arch above left hilum
Height of thorax/Transverse diameter of thorax
Height of thorax/Standing height/ $\sqrt[3]{\text{Body weight}}$
Length of superior portion of mediastinum/ Height of thorax
Height of thorax/Sitting height
Height of thorax/Specific gravity
A-P diameter of thorax/Sitting height
Height of thorax/Standing height
Length of superior portion of mediastinum/ Sitting height
Lenth of superior portion of mediastinum/ Standing height
Height of aortic arch above left hilum/ Height of thorax
Height of aortic arch above left hilum/ Sitting height
Actual area of the heart.

No significant age changes were found for the following thoracic features:

Transverse diameter of thorax
Relative height of hila of lungs
Height of aortic arch above cardio-aortic junction/Height of thorax
Transverse diameter of heart/Transverse diameter of thorax.

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Relation Between Age and Tissue Response to Stimuli. A Review

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THE changing reactivity of tissues with increasing age has long been recognized, and particularly the loss of growth capacity with advancing differentiation has been extensively studied in plants, lower forms of animals, and mammals. Age changes occurring in tissues and body fluids may be studied by biochemical, biophysical, or morphologic methods. Some of these age changes are latent and do not become manifest until stimuli are applied. The knowledge of both manifest and latent age changes is a prerequisite for an evaluation of the role of age in disease, specifically those diseases which show a definite age distribution such as infections, arteriosclerosis, arthritis, cancers, and the like.

In the course of time, many data on aging and the pathology of aging have accumulated (1, 2, 15). However, studies on random human populations have to cope with the difficulties arising from observations on uncontrolled material. It was an important step forward when Loeb (9-13) introduced genetically uniform strains of mice as material for the study of age changes and thus laid the groundwork for much of the subsequent systematic research on aging. Our own investigations deal primarily with skeletal aging and with the significance of age in tumorigenesis (17-22).

Microscopic examination of the skeleton of various species has disclosed a distinct pattern of growth, development, and senescence. These processes may be graphically presented in a time curve which is peculiar to the skeleton but which may show certain similarities to the time curve of other organ systems of individuals of the same strain. In the skeleton, one may recognize three phases of the skeletal time curve: during the first phase, epiphyseal growth is accentuated, during the second phase breakdown of epiphyseal cartilage and growth of bone are prominent, during the third phase increasing resorptive processes lead to epiphyseo-diaphyseal union and, in old age, to osteoporosis. Different strains of mice as well as males and females of the same strain vary as to the time of onset and duration of these phases. Thus in individuals of the same species but of different strains, identical stages of development and senescence may occur at different ages in terms of time; in other words, mice of the same chronologic age may vary regarding the state of development of their skeleton. Obviously then, studies on the role of age in tissue susceptibility to stimuli will have to take into account not only the chronologic age of an individual but also its physiologic age. Physiologic age may be defined as the chronologic age of a tissue as modified by the cumulative effects of internal and external factors acting or having acted on this tissue up to the specified age.

In a general way, the primary reaction of a tissue to a stimulus may be progressive, that is productive of growth, or it may be regressive, and thus reflect a loss of vitality. The ability of a tissue to react with growth is contingent upon the presence of cells possessing growth potential. In the skeleton, a growth-promoting or a growth-inhibiting agent will be able to exert an effect only as long as the cartilage possesses growth capacity. Similarly, stimuli that produce ossification will evoke a response only as long as bone growth is in progress. However, at a time when resorptive processes

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are predominant, bone-forming stimuli will assert themselves only with difficulty.

While the growth capacity of the epiphyseal cartilage declines with advancing age and finally ceases altogether, the articular cartilage retains its ability to proliferate and to develop through life. The articular cartilage of an individual is thus at any given age physiologically younger than the epiphyseal cartilage. Hence, a growth stimulus which fails to elicit a reaction in the epiphyseal cartilage still may call forth proliferation of the articular cartilage.

These characteristics of the tissues must be kept in mind in an evaluation of the effects of stimuli acting on tissues at different ages (17). Of considerable interest in this connection are certain hormones. Among these, anterior hypophyseal hormones in the form of crude extracts, or of antuitrin, or of transplants of anterior hypophyses exert several effects on the cartilage. The hormone may stimulate cell growth and, at the same time, may soften the matrix. The latter effect is obviously of degenerative character. The age of the tissue largely decides which of these effects shall predominate.

In young mice and guinea pigs, in which the growth capacity of the cartilage is high, the growth-promoting effect of the anterior hypophyseal hormone is conspicuous in both the epiphyseal and articular cartilages. In young adult animals in which the epiphyseal cartilage shows advanced degeneration, the hypophyseal hormone will intensify regressive changes in the epiphyseal cartilage. On the other hand, in the articular cartilage, which retains growth capacity through life, the hormone will at first stimulate growth. These growth processes are, however, followed by rapid degeneration leading to osteoarthritic changes. This role of the age factor can be discerned also in cases of acromegaly: in young adult patients, proliferation of the articular cartilage is marked, while in aged patients rapid breakdown of the proliferating cartilage is seen (17).

Similar age differences in the response of tissues to stimuli may be observed following injections of thyroid hormone. In young animals, the hormone accentuates development of cartilage in association with condensation of cells and matrix; in animals that have ceased to grow, thyroid hormone will elicit no growth but will intensify the processes of resorption (17).

Ovariectomy delays skeletal aging when performed in young animals. When performed in old animals ovariectomy will exert little or no effect on the skeleton. Estrogenic hormone has the opposite effect to ovariectomy. When administered to young mice, estrogen suppresses growth, induces hyalinization and calcification of connective tissue and cartilage and thus creates conditions favorable to bone formation. When given to old animals, the condensing and ossifying effects of the hormone are interfered with by the resorptive processes which are physiologic at that age (17).

One fact seems noteworthy: even though these various hormones such as anterior hypophyseal, thyroid, and estrogenic hormones all resemble one another in that under certain conditions they may accelerate skeletal development and aging, the mechanisms by which these hormones accomplish their effects are different. While anterior hypophyseal hormone softens and liquefies cells and matrix, both the thyroid and estrogenic hormones harden and condense the tissues. These dual effects find their counterpart in the two types of spontaneous age changes occurring in the cartilage, namely liquefaction on the one hand, and calcification and sclerosis on the other.

Hormones are not the only factors that promote skeletal development and aging. Feeding a fat-enriched diet to male mice of strain C57 black hastened skeletal aging and increased the incidence of osteoarthritis about twofold, the entire chain of events being comparable to that observed after administration of hypophyseal hormone, although the effect of this diet was less marked than that of the hormone. If the diet was given from the ages of 1, 6, or 12 months, the incidences of osteoarthritis were 59.5 per cent, 60.4 per cent, and 65.5 per

cent respectively. Thus, the incidence of the disease was about equally high in mice of all age groups in spite of the fact that in the second and third age group the diet was given for 5 or 11 months less than in the first age group. These observations suggest that the susceptibility to osteoarthritis increases with advancing age (18). Investigations are in progress to test further the validity of this assumption.

Table 1. Effect of High-Fat Diet and Age on Susceptibility to Osteoarthritis.

Group	Number of Mice	Mean Age (Months)	Conditions in the Knee Joints of Mice Fed the Control and High-Fat Diets		
			Percentage of Mice Showing		
			No Change	Age Changes	Osteo-arthritis
Control Diet through life	113	17.2	13.9	54.4	31.9
High-fat Diet from 1 month on through life	111	16.1	9.9	30.6	59.5
High-fat Diet from 6 months on through life	48	16.1	2.1	37.5	60.4
High-fat Diet from 12 months on through life	32	20.7	0.0	34.4	65.6

Following stimulation by hormones or under the influence of nutritional factors, the primary growth reaction as well as the subsequent regressive changes were more pronounced in the male skeleton than in the female skeleton; similarly, the skeleton of the slowly developing strain C57 black was more susceptible to these influences than that of the rapidly developing strain Dba (22). These findings suggest that in females or in individuals of rapidly aging strains the relatively advanced physiologic age of the skeleton is responsible for the decreased growth response.

An age factor also plays a significant role in the development of cancer, in particular in the susceptibility to carcinogenic stimuli. Most cancers in man and animals have a peak incidence at certain ages (10, 16). Possibly, therefore, during life gradients of susceptibility to cancerous stimulation exist. It was Loeb (10-13) who first investigated the role of age in the induction of mammary cancer by estrogen. He demonstrated a maximum susceptibility to estrogen if the treatment was begun about the onset of sexual maturity. Following his line of studies, we carried out experiments in male castrate mice of high-mammary cancer strains (19-21). Mammary stimulation was produced by grafting anterior hypophyses and ovaries or by injecting estradiol benzoate into animals of various ages. The older the animal at the beginning of the treatment, the smaller was the yield of mammary cancers and also the less pronounced was the non-cancerous hyperplastic mammary growth. A number of these mice developed leukemia, and the incidence of leukemia decreased as the age of the animals at the time of treatment increased.

A few other observations on the role of age in experimental tumorigenesis may be mentioned: The leukemogenic action of radiation seems to reach a peak if applied at about the onset of sexual maturity, the effectiveness declining gradually thereafter (6, 7). Likewise, the incidence of urethane-induced lung tumors declined as the age of the animal increased at the time of exposure to the carcinogen (14). The effect of polycyclic hydrocarbons is at least in some strains contingent upon the age of the animal at the time of application of the carcinogen (3, 4). The growth of virus-induced avian cancers is likewise modified by the age factor (5). Hypophyseal gonadotrophins are

TABLE 2. INCIDENCE AND TIME OF APPEARANCE OF MAMMARY CANCERS IN CASTRATE AND NON-CASTRATE MALE MICE OF STRAIN C3H TREATED WITH ESTROGENIC HORMONE AT VARIOUS AGES.

Experiment	Injected from the Age of	Number of Mice Reaching Minimum Cancer Age	Mean Age at Death of all Mice (Months)	Mice with Mammary Cancers		
				Number of Mice	Percentage of Total	Mean Age at Death (Months)
Castrates	1 month	18	12.9	8	44.4	9.7
Controls	1 month	19	12.8	3	15.8	10.7
Castrates	4 months	40	13.0	12	30.0	12.8
Controls	4 months	25	10.8	1	4.0	17.0
Castrates	7 months	29	16.8	4	13.8	13.0
Controls	7 months	34	16.7	1	2.9	12.0

TABLE 3. INCIDENCE AND TIME OF APPEARANCE OF MAMMARY CANCERS IN CASTRATE MALE MICE OF STRAIN A RECEIVING ANTERIOR HYPOPHYSEAL, OVARIAN GRAFTS, OR A COMBINATION OF ANTERIOR HYPOPHYSEAL AND OVARIAN GRAFTS AT VARIOUS AGES.

Type of Graft	Number of Mice	Mean Age at Death of all Mice (Months)	Animals with Mammary Cancers		
			Number of Mice	Percentage of Total	Mean Age at Death (Months)
I. Anterior hypophyses at 1 month	28	16.1	0	0	....
II. Ovaries at 1 month	27	16.9	1	3.7	6.5
III. Anterior hypophyses and ovaries at 1 month	26	17.1	8	30.8	12.9
IV. Anterior hypophyses at 7 months	28	19.1	0	0	....
V. Ovaries at 7 months	26	15.9	0	0	....
VI. Anterior hypophyses and ovaries at 7 months	29	15.8	0	0	....

most powerful stimuli to follicular growth if administered shortly before the onset of sexual maturity, although intrasplenic grafts of old ovaries may show a marked growth response in young hosts (8). It seems probable that further studies will disclose in increasing numbers similar patterns of gradients of tissue susceptibility to stimuli with advancing age.

We may then summarize our principal conclusions about as follows: the age of maximum susceptibility to stimuli varies with species, strain, and sex of the individual; it varies also with the tissue on which the stimulus acts and with the type of stimulus applied. As a rule, the sensitivity of a tissue to stimulation seems to be the more marked the more similar the effects of the stimulus would be to the physiologic processes in progress at the time of stimulation. The decline in susceptibility of a tissue to growth stimulation in aged individuals agrees with the fact that senescent tissues suffer from impaired nutrition due to vascular changes and to changes in the intercellular matrix. Such changes are necessarily unfavorable to growth.

The fact that the peak of susceptibility oc-

TABLE 4. INCIDENCE AND TIME OF APPEARANCE OF MALIGNANT LYMPHOID TUMORS IN CASTRATE AND NON-CASTRATE MALE MICE OF STRAIN C3H TREATED WITH ESTROGENIC HORMONE AT VARIOUS AGES.

Experiment	Injected from the Age of	Mice Reaching Minimum Lymphoma Age	Mean Age at Death of all Mice (Months)	Mice with Malignant Lymphoid Tumors		
				Number of Mice	Percentage of Total	Mean Age at Death (Months)
Castrates	1 month	19	13.2	6	31.6	13.5
Controls	1 month	19	12.8	4	21.1	15.0
Castrates	4 months	34	13.9	2	5.9	18.0
Controls	4 months	14	13.5	1	7.1	18.0
Castrates	7 months	24	17.6	1	4.2	17.6
Controls	7 months	29	20.8	0	....	20.8

TABLE 5. INCIDENCE AND TIME OF APPEARANCE OF MALIGNANT LYMPHOID TUMORS IN MICE OF STRAIN A ORCHIDECTOMIZED AT THE AGE OF 3 WEEKS AND GRAFTED AT THE AGES OF 1 OR 7 MONTHS RESPECTIVELY.

Type of Graft	Number of Mice	Mean Age at Death of All Mice (Months)	Animals with Malignant Lymphoid Tumors		
			Number of Mice	Percentage of Total	Mean Age at Death (Months)
I. Anterior hypophyses at 1 month	28	16.4	7	25.0	16.6
II. Ovaries at 1 month	28	18.2	7	26.9	20.0
III. Anterior hypophyses and ovaries at 1 month	25	17.4	9	36.0	18.7
IV. Anterior hypophyses at 7 months	28	19.3	3	10.7	22.0
V. Ovaries at 7 months	25	16.8	2	8.0	15.0
VI. Anterior hypophyses and ovaries at 7 months	29	15.7	4	13.8	17.5

curs only after the organism has reached a certain age is not easily explained. Several possibilities may be suggested: Cells may have to reach a certain stage of development and specialization before they become responsive to stimuli. This seems to apply for instance in the case of ovarian follicles. Another possibility may be seen in the fact that young cells multiply so rapidly that their rate of growth is near the physiologic limits. Additional stimulation, therefore, will not evoke much additional growth, while the same stimuli may exert conspicuous effects once growth of these cells progresses at a lowered rate. Extensive work will have to be carried out before the ultimate answer to these questions will be known.

SUMMARY

The age of maximum susceptibility to stimuli varies with species, strain, and sex of the individual; it varies also with the tissue on which the stimulus acts and with the type of stimulation applied. The response of a tissue seems to be the more marked the more similar the effects of the stimulus would be to the physiologic processes in progress at the time of stimulation.

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Treatment of Parkinson's Syndrome with Tropine Benzohydryl Ether Methane Sulfonate and Other Drugs

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DURING the past few years numerous papers have appeared on the treatment of Parkinson's syndrome with particular reference to the use of antihistamine drugs. Review of the literature by one of the authors (1) will be found in a previous publication. Generally there is an agreement that dimethylaminoethyl benzhydryl ether hydrochloride (Benadryl), 3-(1-piperidyl)-1-phenyl-1-cyclohexyl-1-propanol hydrochloride (Artane) and the solanaceous alkaloids make up the medical armamentarium in the symptomatic treatment of Parkinsonism (1). There is, however, a disagreement as to whether or not there is a synergistic action between the antihistamine drugs and the solanaceous alkaloids (1, 2, 3). The patients in this study group were followed for about one and a half years prior to this study—the results of which have been reported in the previous publication (1). The effects of some of the drugs and placebos on our patients were, therefore, known before this study was undertaken.

This study was undertaken to compare the two investigational drugs made available for Parkinson's syndrome: namely, tropine benzohydryl ether methane sulfonate (MK-02) and diethyl amino ethyl alpha alpha-diphenyl proprionate hydrochloride (P-19) with Benadryl, Artane, and Rabellon (each Rabellon tablet contains atropine sulfate 0.0372 mg., hyoscyamine hydrobromide 0.4507 mg., and scopolamine hydrobromide 0.0119 mg.). The separate components of Rabellon were also used in various dosages combined with Benadryl and Artane. The results are not included because there was no appreciable benefit from the use of these individually than was obtained with the three combined as Rabellon.

METHOD OF STUDY

The 15 subjects in this study group were patients at St. Louis City Infirmary Hospital. Seven in the group were ambulatory; the remaining 8 were bedridden but were able to sit when helped into a chair. Twelve patients were classified as suffering from post-encephalitic, 2 from arteriosclerotic, and 1 from post-traumatic Parkinson's syndrome. Seven were male, 8 were female, and their ages ranged from 31 to 84 years with an average age of 55 years.

All the 15 patients were subjected to treatment with the drugs mentioned. An alternate control group was not established, but individuals included in the study were observed on placebo administration in order to determine the degree of any psychic effect.

All medications were given orally and they were always added or removed gradually. The effects of medications were observed immediately in severe cases, and even in less severe cases were observed in twenty-four to forty-eight hours. Within three days the adjustment to the change was usually made. As a rule, each change was observed for a period of one to two weeks. This study extended over a ten months' period, and more than one trial with each drug or drug combination was carried out at different times during this period in order to offset the effect of environment and the progress of the disease on the result of treatment.

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For studying the effects of the individual drugs, in the majority of patients medications were added or removed in the following order. When the present investigation was started, all the patients were on combined Rabellon and Benadryl medication. Rabellon was first removed, then P-19 was added, followed by the removal of Benadryl. Then MK-02 was added with the removal of P-19. Rabellon was again added and MK-02 was withdrawn. The effects of Artane alone and in combination with Benadryl and/or Rabellon had been noted in a previous publication (1).

The difficulty in the clinical evaluation of the medications in Parkinson's syndrome has been discussed in the earlier paper (1) and will not be repeated here. The examiners were quite familiar with these patients' symptoms and their general condition, having had them under observation for over a year and a half.

The observations of the effect of the medications were made on the beneficial symptomatic effect of the drugs, the relapse of symptoms following the removal of the drugs, and the side effects. The appraisal of these effects was made by the daily observations of the ward-nurses, by the daily observations of the attending physician, and by the weekly observation of another physician, each made independently.

The symptoms observed in particular were: spasticity, tremors, sialorrhea, seborrhea, oculogyric crisis, hyperhidrosis, and general well-being.

In the evaluation of the clinical condition of the patients, the degree of spasticity was judged from the patients' ability to perform certain standard movements and exercises. In addition the patients' performance of their daily needs, their speech, and their complaints, such as incontinence of urine and muscular pains, were recorded. The strength and clarity of speech was also noted. The tremor was difficult to evaluate as any excitation tends to aggravate it. Sialorrhea was noted in mild cases by the subjective complaints of the patients, in moderately severe cases by the frothing in the mouth when speaking, and in severe cases by the drooling and difficulty in swallowing. Seborrhea was also difficult to evaluate as frequently local salves were being used. The perspiration was also unreliable especially with changes in temperature and weather. Oculogyric crises were, as a rule, reported by the patients when they occurred. A record of the frequency of the oculogyric crises was kept.

It should be mentioned here that in withdrawing medication, a gradual removal is very important. With relapse of symptoms, the patients may develop marked difficulty in swallowing, and aspiration and choking on food particles may cause serious complications.

As for the side effects, because many of the patients were somewhat constipated, nausea and vomiting were evaluated with this in mind since fecal impaction could be the cause of the symptoms. Severe constipation requiring daily cathartics and repeated enemas was, however, considered as an undesirable side effect. Dizziness is a subjective complaint and was accepted according to the reliability of the patients. Since many of the patients had cataracts, visual changes were not dependable. Dilatation of the pupils was, however, watched for with particular attention, since this sign might indicate a developing glaucoma. Dryness of the mouth was observed from the amount of fluids consumed by the patients and from the character of the patients' tongues. The patient with post-traumatic Parkinson's syndrome complained of a sore tongue and mouth throughout the period. All the patients were further under observation for or questioned with regard to excitation, drowiness, and headaches.

The group of 15 patients was divided into 2 subgroups on the basis of the severity of the disease. The first group consisted of 8 patients with severe symptoms and the second group consisted of the remaining 7 with symptoms of less severity.

The point system was used in the appraisal, as it simplifies the final comparative evaluation

of the results. The following system was used:

Questionable effect	1 point
Fair effect	2 points
Good effect	3 points
Very good effect	4 points

Four points in the beneficial symptomatic effect mean that the particular drug alone controlled the symptoms at the dose used, and combining with other drugs showed no further obvious effect, although finer improvements may have been present. Three points mean that further improvement was noted in these patients by the addition of another drug. The degree of effect between 2 points and 3 points was largely on the basis of each observer's subjective appraisal, but 1 point was given when the response was questionable.

Results

Patients No. 14 and No. 15 were removed from the study group during the course of

Table 1. Beneficial Symptomatic Effects of Drugs Singly and in Combination in Parkinson's Syndrome.

Number	Patient	Age	Sex	Diagnosis	Symptoms	Benadryl 100 Mg. 4 x Day	P-19 5 Mg. 3 x Day	MK-02 1 Mg. 3 x Day	Rabellon 1 Tablet 3 x Day	Rabellon 1 Tablet 3 x Day. MK-02 1 Mg. 3 x Day	Benadryl 100 Mg. 2 x Day. MK-02 1 Mg. 3 x Day	Rabellon 1 Tablet 3 x Day. Artane 5 Mg. 3 x Day	Benadryl 100 Mg. 4 x Day. Artane 2 Mg. 3 x Day	Rabellon 1 Tablet 3 x Day. Artane 2 Mg. 3 x Day. Benadryl 100 Mg. 4 x Day
1	E. F.	43	F	P. E.	S	3	1	3	3	4	4	4	4	4(SE)
2	E. L.	46	M	P. E.	S	3	1	3	3	4	4	4(SE)	4	4
3	C. N.	31	M	P. E.	S	3	1	3	3	4	4	4(SE)	..	..
4	C. J.	54	M	P. E.	S	2	..	2	2	4	4	3(SE)	..	..
5	H. R.	44	M	P. E.	S	4	1	3	3	4	4	4	4	4
6	C. B.	64	M	P. E.	S	3	1	3	3	4	4	3	4	4(SE)
7	M. W.	58	F	P. E.	S	3	1	3	2	4	4	3	4	4(SE)
8	V. R.	48	F	P. E.	S	3	1	3	2	4	4	4	4	4
						3	1	2.9	2.6	4	4	3.6	4	4
9	C. M.	60	F	P. E.	M. S.	4	1	4	4	4	4	4	4	4
10	L. P.	84	F	A.	M. S.	4	1	4	4	4	4	4	4	4
11	M. B.	45	F	P. E.	M. S.	4	1	4	4	4	4	4	4	4(SE)
12	V. N.	32	F	P. E.	M. S.	4	1	4	4	4	4	4	4	4
13	R. K.	74	F	P. T.	M. S.	4	1	4	4	4	4	4(SE)	4	4
14	H. M.	75	M	P. E.	M. S.	4	1	4	4	4	4	..	..	..
15	H. K.	67	M	A.	M. S.	4	1	4	4	4	4	..	..	..
						4	1	4	4	4	4	4	4	4

Diagnosis: P. E.—Post Encephalitic
P. T.—Post Traumatic
A. —Arteriosclerotic
Symptoms: S. —Severe
M. S.—Moderately Severe

Side Effect —(SE)
Questionable—1
Fair Effect —2
Good Effect —3
Very Good —4

the investigation as their general condition made evaluation of the effect of the medications difficult.

The table shows the mean beneficial effects of the drugs and the combination of drugs. The dosage of the medications used is also given.

From the table we can see that Rabellon, Benadryl, and MK-02 individually were equally effective in patients with moderately severe symptoms. In the patients with severe symptoms, however, Benadryl seemed slightly more effective than MK-02 and Rabellon. P-19 did not approach anywhere close to the effect of the other drugs. Rabellon, Benadryl, and MK-02 in various combinations of two drugs were effective in all patients. Artane and Rabellon in combination seemed to produce more side effects such as dizziness, severe constipation, and excitation, and this combination was not as effective as other combinations in 3 patients with severe symptoms. Artane alone, 2 mg. three times a day, was not as effective in all patients over long periods of time as were Artane and Benadryl or MK-02 alone.

The dosage of each medication was arbitrarily set from earlier experience and so the comparative effectiveness of the medications must be considered with the dosage in mind. In other words the dose of Rabellon is comparatively smaller than that of Benadryl. The most effective dosage for P-19 and MK-02 has not yet been established, but 1 mg. of MK-02 three to four times daily was used with good effect.

Discussion

We must remember that in a condition such as Parkinson's syndrome there is a gradual progression of the disease. The beneficial effect of these drugs in Parkinsonism is merely one of controlling certain distressing symptoms and not one of curing the primary cause. Thus even under maximal beneficial effect of these drugs, most of these patients, if seen for the first time, may seem far from being well. However, treatment of this kind not only controls the symptoms but it increases the ability of the patients to care for themselves and it enhances their morale.

One must keep in mind the demanding nature of many of the chronically ill patients when evaluating symptoms such as excitement or emotion. Also the patients with arteriosclerosis frequently have a natural periodic weakness and drowsiness. Headaches were present in two patients (No. 11 and No. 12) before the study. Patient No. 11 had headaches, especially with her menstrual period, and the other had a constant occipital headache. This latter patient also had convulsive seizures apparently from a previous craniotomy performed for her Parkinson's syndrome.

During the course of this study we increased the medications to the maximum of Benadryl 100 mg. four times a day, Artane 2 mg. three times a day, and one of the components of Rabellon (hyoscyamine hydrobromide 0.4507 mg. tablet) three tablets three times a day given at the same time. The undesirable side effect appearing in a number of the patients outweighed the finer improvements, if any, that may have occurred.

Generally speaking, the symptoms which showed the greatest beneficial effect were: the sense of well-being with improvement in appetite, gain in weight, and more pleasant disposition, the decrease in spasticity with increase in their ability to perform their own daily routines with greater ease, and the control of excessive perspiration and salivation.

It was our impression that although these patients tolerated the medications well in high dosages when gradually increased, there was a suggestion of an aggravation of the symptoms upon subsequent reduction in dosage to a previously effective level.

The side effects observed seemed to be predominantly due to Artane and the solanaceous alkaloids in higher dosage and consisted mainly of dizziness, dry mouth, excitation, and severe constipation.

The toxic effects such as albuminuria, agranulocytosis, and cardiac arrhythmia were watched by means of appropriate laboratory methods

but none was encountered during the period of this study.

Concerning a synergistic effect of antihistamine drugs and the solanaceous alkaloids, a definite beneficial effect of combined therapy was observed in patients with severe symptoms. In patients with less severe symptoms one effective drug given alone will be sufficient, although in an individual patient one drug may seem superior to another. In the majority of the patients, however, there will be little difference in the beneficial effect of these drugs.

We are inclined to believe that there exists an additive effect, if not a synergistic one, between the antihistamine drugs and the solanaceous alkaloids in the treatment of Parkinson's syndrome, in that the optimal effect is produced with minimal side effects by their combination. We consider that it is not advisable to increase the dose of the drugs, although they are well tolerated by these patients once the optimal effect is reached, since the side effects outweigh any further finer improvements obtained and since there was a suggestion that the subsequent lowering of the dosage caused the patients to exhibit symptoms which seemed to have been controlled previously on the lower dose.

Summary

A comparative study of the effects of MK-02, P-19, Benadryl, Artane, and Rabellon, and various combinations of these drugs was carried out on 15 patients with Parkinson's syndrome who had been under observation for one and a half years prior to this study, which extended over a ten months' period.

The results of the two investigational drugs are as follows: tropine benzohydryl ether methane sulfonate (MK-02) has been found to approach the anti-Parkinson effect of Benadryl and Rabellon, whereas diethyl amino ethyl alpha alpha-diphenyl proprionate hydrochloride (P-19) did not have nearly the beneficial effect of the other drugs. Both drugs (MK-02 1 mg. three times a day and P-19 5 mg. three times a day) were well tolerated by the patients during the period of their trial.

O'Leary (4) has followed a group of patients with Parkinson's disease in the Neurology Clinic of the Washington University School of Medicine and believes that MK-02 is about 15 to 20 per cent more effective than Artane and seems to exhibit its effectiveness better with long continued usage. Dosages of MK-02 varied from 3 to 6 mg. daily. Dosages of Artane usually were 4 to 6 mg. daily with a maximum of 15 mg. daily in some cases.

We wish to thank Merck & Co., Inc. for the MK-02 (tropine benzohydryl ether methane sulfonate) and MK-02 placebos; Sharp and Dohme for the Rabellon, Rabellon placebos, atropine sulfate 0.0372 mg. tablets, hyoscyamine hydrobromide 0.4507 mg. tablets, and scopolamine hydrobromide 0.0119 mg. tablets; Parke Davis and Co. for the Benadryl (dimethylaminoethyl benzhydryl ether hydrochloride) and Benadryl placebos; Abbott Laboratories for the P-19 (diethyl amino ethyl alpha alpha-diphenyl propionate hydrochloride); and Lederle Laboratories Division, American Cyanamid Co., for the Artane (3-(1-piperidyl)-1-phenyl-1-cyclohexyl-1-propanol hydrochloride) and Artane placebos.

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Personality of Young and Middle-Aged Normal Men: Item Analysis of a Psychosomatic Inventory

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This study represents a small segment in a broad cooperative research focused on aging of the cardiovascular system, especially on the development of hypertension. The backbone of the project is a large group of middle-aged men, free from disease and aged 45 to 55 years at the start of the study, who undergo yearly comprehensive examinations. Thus the research is essentially longitudinal in character and the returns are necessarily slow. For purposes of standardization of some of the newly introduced methods and in order to obtain data on changes which already had taken place in the older men during maturity, a group of younger men, college students when the research was initiated, was included.

In the present study a comparison was made of responses of the younger and older men in a psychosomatic inventory designed to throw light on those aspects of personality which were described in the literature as being characteristic of individuals who develop essential hypertension. Here we are concerned only with age differences. The samples are restricted to individuals who are clinically normal and whose blood pressure is below 140 mm. Hg. systolic and 90 mm. Hg. diastolic.

Materials and Methods

The subjects were volunteers recruited from the University of Minnesota students and from local business and professional groups. In the second year of the investigation—the year during which the psychosomatic inventory was administered—the men in the younger group averaged 21.9 years (range 18 to 26, N = 119), in the older group 50.3 years (range 46 to 56, N = 200).

The inventory (qualified investigators may request a copy), developed in this laboratory in cooperation with Joslin for the study of "hypertensive personality," was patterned after the Minnesota Multiphasic Personality Inventory (7). It consists of 228 statements, mostly phrased in the first person, bearing on different personality characteristics which were considered by various authors as constituting the hypertensive personality. A thorough review of the literature revealed that some 75 personality traits and emotional reaction patterns have been considered as being correlated with an elevated systemic blood pressure.

Perfectionistic tendencies are one such characteristic. To check the presence or absence of this trait several items were developed ("I have always gone by the old saying that anything that isn't worth doing right isn't worth doing at all." "Neatness is very essential to me."). These items were marked by the subjects as True, False, or Uncertain. Each subject was given oral explanation concerning the purpose of the inventory and instructions as to how to proceed.

In addition, the following instructions were printed on the inventories: "These questions are asked in an effort to learn more about the differences between people who develop high blood pressure and those who do not. If you can answer these questions truly and accurately as they apply to you, you can help in this study. This questionnaire is a confidential report. Remember, there are no right or wrong answers. If the statement is true, circle T. If the statement is false, circle F. If you cannot answer the question, circle the question mark (?). The study will be most valuable if you circle as few question marks as possible."

For computational purposes only the definite (Yes or No) answers were considered. The number of Uncertain answers was small; for items differentiating the groups at 1 per cent

level of statistical significance, the average percentage of "Cannot say" answers was about 5 in the younger group and 4 in the older group.

The inventory is not provided with special validation scales but the experience with the Minnesota Multiphasic Personality Inventory (4), administered in the same group a year earlier, leads us to believe that carelessness, lack of understanding, or an excessive tendency to place oneself in a socially acceptable light did not affect the validity of the results obtained with the present questionnaire.

Results

The items differentiating the two age groups at the 5 per cent level of statistical significance or better are presented in table 1. On the basis

Table 1. Item Analysis.

The 5 per cent level of significance of the difference between the frequency of "Yes" responses in the younger and older group is indicated by a critical ratio of 1.96, the 1 per cent level by a critical ratio of 2.58.

% "Yes" Responses				
Item	Younger Men N = 119 (Range 18-26)	Older Men N = 200 (Range 46-56)	Critical Ratio	Item
				Health
15	86	69	3.11	My muscles are still quite hard.
42	1	7	2.52	Am bothered by aches and pains of some sort most of the time.
162	12	23	2.56	My skin frequently itches.
167	92	79	2.85	Never have had much trouble with bowels and stomach.
154	12	30	3.68	I've been bothered with constipation.
				Recreation and Sports
24	79	65	2.66	Very much enjoy taking part in group activities.
43	24	37	2.49	Since growing up I haven't spent much time in recreation.
46	94	79	3.62	Enjoy picnics.
100	7	30	4.78	Would much rather sit inside and read, listen to the radio, or talk than to take walks or play active games.
118	43	26	3.12	Will attend party any time I have chance.
159	9	19	2.41	Physical exercise doesn't appeal to me.
164	13	29	3.27	Taking part in sports like boxing and football never appealed to me.
170	23	62	6.66	Know of nothing I'd rather do than spend quiet evening at home.
202	62	76	2.46	Have frequently had to be driving force in activities I have taken part in.
				Home and Family
2	44	56	2.06	Could never stand to be dependent on anyone.
81	26	16	1.98	Whenever I needed help I always went to my parents.
83	28	14	3.22	Have felt at times that I hated members of my family.
119	50	30	3.59	Sometimes my mother has made me so angry I've felt like blowing up.
149	78	89	2.48	Fought battles without running to my parents even as a child.
177	88	76	2.65	Never liked being "babied" at home.
192	49	10	7.81	Obtain most of my pleasure away from my family.

TABLE 1. ITEM ANALYSIS.—*Continued*

% "Yes" Responses				
Item	Younger Men N = 119 (Range 18-26)	Older Men N = 200 (Range 46-56)	Critical Ratio	Item
				Self-confidence
19	26	8	4.20	Must admit a constant inner feeling that I won't "make the grade."
57	15	40	4.45	Even after working hard I've never been able to reach the top.
73	32	44	1.98	Never have trouble making decisions.
94	37	53	2.67	When faced with a new situation I never worry about failure.
152	62	38	4.10	Sometimes get into position where I feel helpless.
173	34	48	2.41	Almost nothing can stop me from carrying out a course of action I've decided upon.
223	48	62	2.48	Never have trouble deciding whether or not to take the lead in certain situations.
				Emotional Adjustment
11	10	22	2.69	Am undoubtedly more easily hurt by criticism than average person.
28	14	34	3.88	Often drink over 5 cups of tea or coffee per day.
44	45	60	2.39	In spite of fact that I have lots of inner tensions I keep them well covered.
69	37	25	2.23	Have disturbing ideas that keep running through my mind at times.
74	57	68	2.01	Sometimes I feel more angry inside than I think I should.
87	9	25	3.36	My muscles often feel tight or tense.
102	88	75	2.61	Rarely smoke over a pack of cigarettes (or 3 cigars) (of ¼ can of pipe tobacco) per day.
109	18	10	1.96	Have never "blown my top."
116	30	44	2.46	Have never been able to keep a poker face when upset.
121	80	63	3.02	Am calm and easy-going.
123	16	27	2.15	Sometimes feel my mind is working so fast I have trouble keeping up with it.
136	66	77	2.06	Am not a person subject to marked ups and downs.
141	77	66	2.04	Easily get over feelings of having been wronged.
161	0	19	5.04	Take drink of whisky, highball, or several bottles of beer daily.
172	65	50	2.62	Have never been easily moved to tears.
181	38	50	2.15	Excitement causes my heart to flutter occasionally.
215	20	39	3.57	At times my stomach feels like it is in knots.

of a subjective analysis the items were grouped together under several headings.

A number of questions, 12 to be exact, in which the difference reached or exceeded the 5 per cent level of significance, were inapplicable to the younger men and were psychologically meaningless. As an example, the following items may be cited: "Have three or more children;" "Have never been married;" "Make most decisions about family matters;" and "Got as far as I wanted to in school." These items have not been tabulated.

In the qualitative description of the differences between the two age groups only the

TABLE 1. ITEM ANALYSIS.—*Continued*

% "Yes" Responses				
Item	Younger Men N = 119 (Range 18-26)	Older Men N = 200 (Range 46-56)	Critical Ratio	Item
				Interpersonal Relations
20	78	59	3.38	When among friends who are discussing feelings and personal problems I join right in.
34	71	84	2.71	Could never stand a lot of fighting or arguing at home or at work.
53	14	36	4.36	Wouldn't remove my coat in a group where others kept theirs on even though I were warm.
86	47	64	2.78	If someone seems angry with me it hurts me greatly inside.
95	44	76	5.63	Usually keep troubles to myself even when others are talking about theirs.
113	70	82	2.48	Am usually at ease with group of new acquaintances.
122	59	36	3.84	I talk lots.
131	45	58	2.28	Bothers me to attract attention of crowd by arriving late.
132	60	40	3.51	If I dislike someone I don't care whether they know it or not.
133	96	87	2.45	Am a warm-hearted person.
179	82	70	2.27	Express my views readily in a discussion group.
				Standards of Conduct
4	50	63	2.19	Have always gone by the old saying "anything that isn't worth doing right isn't worth doing at all."
59	14	4	3.19	If the going gets tough for me I sometimes choose "wine, women, and song" as a way out.
66	90	81	2.10	I've never been one who closes his mind to the argument of the other side.
67	45	65	3.30	Always suffer later because of conscience if I step out of line.
79	41	65	3.95	My life is made more simple by keeping on a definite schedule.
115	41	72	5.26	My work always comes before my fun.
125	27	47	3.42	Wouldn't like to see people at resort towns parading through hotel lobbies in bathing suits.
124	66	90	5.34	Bothers me a lot to see others cheat.
138	66	85	3.70	Even if no laws I wouldn't be able to do much wrong because of way I'd feel inside.
147	75	91	3.88	Hardly ever late for appointments.
175	68	84	3.40	Don't think there is excuse for shirking on job.
219	39	22	3.25	If I weren't checked on at times my work would suffer some in quality or quantity.

direction of the difference can be adequately considered. For a proper interpretation of the data both the absolute frequency of responses to a given item and the magnitude of the difference should be taken into account. For the age comparison the slightly greater occurrence of aches and pains in the older group is of some interest. For the characterization of the sample the fact that only 7 per cent of the older men have registered the complaint that

they are "bothered by aches and pains of some sort most of the time" is of importance. It is the quantitative aspect of this study which, in our opinion, constitutes its principle merit. The general, qualitative differences confirm what we largely know from everyday experience.

Health.—As noted above the older men complain a little more frequently of aches and pains but the group as a whole is anything but hypochondriac. Itching of the skin has also been noted but the item which differentiates the two age groups most sharply is the higher frequency of constipation in the older men. A large number of these men consider themselves in a good physical shape but the difference is in favor of the younger subjects.

Recreation and sports.—Physical exercise has a lesser appeal to the older men. They prefer, as a group, spending quiet evenings at home reading and listening to the radio to active games. The retrospective statement that taking part in sports like boxing or football had never appealed to them may reflect more accurately their present preferences than their actual attitudes during the days when it would have been likely for them to engage in such activities. However, "secular" cultural shifts in attitudes cannot be excluded from any age comparisons.

They enjoy less picnics and group activities in general, and spend less time in recreation, although the absolute level of participation in both age samples is high. When they do take part in social activities, they are more likely to be the driving force.

Home and family.—One of the most striking differences between the two groups is that the younger men get most of their pleasure away from their family. This is a complex fact. For the younger men "family" means in most cases the parental home whereas the older men have long established their own home. The fact that the younger men left their home to go to school may have inflated this difference. But the age-old antagonism between fathers and sons is not absent and the younger men noted in almost one-third of the cases having felt that they hated members of their family. Fully one-half of them recalled having been made so angry by their mother that they felt like "blowing up." They disliked being "babied" at home but they indicated greater dependence on their parents than the older men did.

Self-confidence.—On the whole it is the older subjects who show a greater self-confidence. The younger men are more frequently concerned that they will not be successful in reaching their goals and in meeting new situations. They get more often into situations in which they feel helpless, experience more difficulty in making decisions, and carry out a course of action with less determination. It represents realism rather than feeling of inferiority where the older men acknowledge that in spite of hard work they were unable to reach the top.

Emotional adjustment.—Throughout, the older men tend to evidence a greater amount of tension and a greater responsiveness to emotional stimuli. They are less calm and easy-going than the younger men. Their muscles often are tense and their stomach feels at times like it is in knots. They are more easily hurt by criticism but they get over it more quickly. They are more easily moved to tears but on the whole they are more reserved in the expression of their feelings and fluctuate less in their mood. They are likely to feel angry inside and keep their tensions well covered up. Their intake of coffee, tobacco, and alcohol is higher. There was no consistent difference in the tendency to obsessive ideas.

Interpersonal relations.—The older men are less outgoing than the younger ones. They talk less and express their view in a discussion group less readily while they meet new acquaintances with ease. They keep their troubles and personal problems to themselves. When they dislike somebody, they are discrete about it. They are more sensitive to the way other people feel about them and they suffer when there is fighting or arguing at home or at work. They feel more keenly the group approval or disapproval.

Standards of conduct.—The principle age difference is the greater rigidity and conscientiousness of the older subjects. It is reflected most markedly in reference to work. Work always comes before fun. They are rarely late for appointments. They are perfectionistic in their attitudes and standards of right or wrong are a part of them. Compliance with law requires less external compulsion. They dislike to see others cheat or shirk on the job. If they step out of line, their conscience bothers them later. They prefer routine and definite schedule. They are less willing to listen to the argument of the other side and are more conservative in matters of clothes. They would not choose "wine, women, and song" as a way out of a tough situation.

Discussion

Much of the current gerontologic research, concerned with "normal" processes of aging, is a by-product of investigations carried out for other purposes (11). In a measure this applies also to the present study. The overall research program within which this work was carried out is focused on aging of the cardiovascular system, with emphasis on the development of hypertension, arteriosclerosis, and coronary artery disease.

The inventory was designed for the evaluation of psychologic characteristics of individuals, normal at the start of the study, who will later develop essential hypertension. It is believed that this approach will allow the testing of the hypothesis that there is a cluster of traits which constitute the "hypertensive personality." Although the inventory was not constructed for the purpose of studying age trends as such, we believe that the results are worth reporting. To a large degree the data provided by this questionnaire confirm and supplement the picture of age differences obtained by the item analysis of the Minnesota Multiphasic Personality Inventory (4).

Systematic work on personality changes with age is hampered—in addition to such mundane and peripheral factors as difficulties in obtaining financial support and suitable subjects for long-range studies—by the absence of satisfactory comprehensive tools for the description of normal adult personality. This has, of course, deeper roots in the lack of clarity and unanimity about the concept of personality itself. The concept has strikingly different "widths" in the usage of different practitioners of the art and science of psychology. Consequently, the selection of the crucial facets of personality and of the tools for their description will vary widely. The conceptual organization of personality shows marked divergences in the formulation of a psychoanalyst, a Meyerian psychobiologist, or a factor-analytically oriented psychologist. We are not wed to any "school," except that of the scientific method. In order to arrive at a more complete overall picture of personality we have used, in addition to the two inventories noted above, Cattell's 16-Personality-Factor Test—a fairly comprehensive questionnaire with behavior characteristics grouped together on the basis of the statistical factor analysis—and two "projective" techniques: Rosenzweig's Picture-Frustration Study and an abbreviated Thematic Apperception Test.

The two age groups compared in the present paper are located close to the outer ranges of maturity (adulthood), the longest segment of man's life cycle. In comparison with the rapidity of growth and development during childhood and adolescence and the rate of involution during senescence, the middle age is a period of greatest stability. However, there is only a slowing down of the changes in morphologic, biochemical, and physiologic characteristics, not their absence. From this laboratory age changes during maturity were reported for such functions as flicker fusion frequency (2), blood level of cholesterol (9), and the electrocardiogram (12). Changes in body composition are more marked than has been previously suspected. Whereas in the younger men of standard weight for height and age the body fat accounts for about 10 per cent of the total body weight, in the older men this value is more than doubled (3).

The literature, scanty and scattered, on psychology (personality) changes during maturity was summarized recently by Cattell (5). He noted the absence of systematic knowledge of age trends in general personality traits ("factors"), such as emotional stability, dominance-submission, or cyclothyme-schizothyme tendencies. Pressey, Janney, and Kuhlen (10) stressed, rightly, that important personality changes are going on throughout the adult years and that life represents a continuing process of adjustment. These adjustments are particularly crucial during the third decade of life (vocation, marriage, parenthood). Obviously, the college students have not yet made a full adjustment to the opportunities, demands, and frustrations of adulthood. Cattell (5, p. 621) listed the following problems to be solved by an individual reaching for the adult status: achieving emotional independence of parents, obtaining economic and occupational status, fitting the approved pattern of differentiated masculinity or femininity, finding a mate, and adjusting to adult cultural standards. Subjects five to ten years older than our sample of young men would have provided a better frame of reference for age changes during maturity, in the full sense, and old age.

In contrast to childhood plus adolescence and senescence, the psychologic study of the process of achieving maturity has been studied much less intensively. Particularly the personality changes with age of the "normal" individuals deserve more attention—individuals who constitute the great but scientifically neglected majority of the population who stayed off the unemployment payrolls, did not go to jail, and did not take up residence at some other institution. In the present study the older men, drawn from professional and business circles, represent the more successful and responsible element in the community. The only personality characteristics, excluding intelligence, investigated on a comparable socio-economic segment of the population are the interests, man's likes and dislikes, studied systematically by Strong (13).

As in the studies carried out by Welford and his collaborators (14), the older men might reasonably be the elder relatives of the younger subjects. This is an important point, essential to the study of age trends not contaminated by other factors. However, we do not wish to delude ourselves that we have or that anybody can provide in personality research truly comparable age groups. The childhood experiences, generally acknowledged as factors importantly molding one's personality, are different in different age groups due to the progress in the cultural and social patterns.

Within the span of thirty years separating, on the average, our two age groups, rapid and profound changes have been taking place in the "invisible environment" of American culture, including changes in social, educational, and material conditions. Pressey, Janney, and Kuhlen (10, p. 95) documented the dramatic changes in recreation, taboos, fashions, and personal habits. These differences, which we are unable to allow for at present, constitute dangers and limitations inherent in all cross sectional studies of personality development. We have to accept that, in a strict sense, the environmental background of different age groups cannot be equated (14, p. 8). The effect of these differences on different aspects of personality will certainly vary. Thus we can reasonably expect that interests in activities demanding physical agility and stamina will decline with age, regardless of the cultural climate (10, p. 231).

Efficiency of the biologic functioning of the human organism reaches a peak in the third decade, with a slow decline during the fourth and fifth decade, and a more rapid deterioration in the subsequent decades. This time course is followed by many sensory, motor, and intellective functions (1). However, it is not a universal pattern. Foulds and Raven (6) have shown that the general fund of information, as measured by a vocabulary test, may grow up to the age level of 40 to 50 years of age while the capacity to make comparisons and to reason by analogy showed a steady decline; using the 20 year old group as a reference point, the following average percentile

values were obtained at the age levels of 20, 30, 40, 50, and 60 years in the reasoning test: 50, 48, 43, 40, and 38. Differential trends have been noted in physical features (8). It may be expected that personality characteristics will not show any simpler pattern.

The inventory used in the present study contained 216 items considered applicable to both the younger and the older men. In 68 items the incidence of the "Yes" responses in the two age groups was statistically significantly different at the 5 per cent level of significance or better. It is known that in testing a large number of items for significance, a certain fraction of them may be expected to yield a statistically significant critical ratio even though there is actually no difference between the population (true) incidence values. Is 68 sufficiently larger than this number?

The fraction depends on the total number of items (N) and the accepted level of significance (p). In the present study $p = 0.05$, corresponding to the probability level of 5 per cent considered as criterion for acceptance of a significant difference. Each item will show either a significant or nonsignificant difference. If p is the probability that a single item will be significant by chance, $q = 1 - p$ gives the probability that the item will not show such a difference. Testing N items corresponds to making N trials of the hypothesis that there are no significant personality alterations associated with aging.

The probability of chance occurrence of significant differences follows a binomial distribution. Because our N is large, the binomial distribution can be approximated by the normal distribution with a mean $m = Np$ and standard deviation $\sigma = \sqrt{Npq}$. For $N = 216$, $p = 0.05$, and $q = 0.95$, the mean number of critical ratios which may be expected to turn out significant by chance is $m = 10.8$ and $\sigma = \sqrt{10.26} = 3.2$. Consequently, the interval of normal expectation corresponds to $m \pm 3.2 =$ 1 to 20. Our value of 68 significant items yields the critical ratio $(68 - 10.8)/3.2 = 17.9$. The probability of the occurrence of such a value is given by that portion of the normal curve which lies outside $+17.9\ \sigma$ from the mean, i.e., it is practically zero. The number of items with statistically significant differences between the older and younger men is sufficiently great to indicate a non-chance occurrence of such a set of differences (15).

Summary

1. A psychosomatic inventory, designed for the study of personality characteristics associated with the development of essential hypertension, was administered to a group of college students ($N = 119$, mean age 22 years) and of business and professional men ($N = 200$, mean age 50 years).

2. All subjects had a normal blood pressure (upper limit 140/90) and were clinically in a good state of health.

3. The frequency of positive responses to each questionnaire item was determined and the statistical significance of the difference was calculated.

4. The items significantly differentiating the two age groups at the 5 per cent level or better were grouped under the following seven headings: health, recreation and sports, home and family, self-confidence, emotional adjustment, interpersonal relations, and standards of conduct.

5. Although the inventory was not developed for the systematic tracing of age changes in personality, the results contribute to the characterization of aging in successful, healthy middle-aged men in a midwestern metropolitan community.

6. In the course of the investigation originated in 1947 in addition to the "hypertensive" inventory the Minnesota Multiphasic Personality Inventory, Rosenzweig's Picture-Frustration Study, Thematic Apperception Test (6 cards), and Cattell's 16 P(ersonality) F(actor) test were used. The results will be reported in separate communications.

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Adjustment of Older People in Two Florida Communities

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THE discovery of how older people live and adjust to their environments is probably one of the basic problems facing gerontologists at the present time. It is the purpose of this report to describe various aspects of the general adjustment of the senior population of two communities, St. Cloud and Winter Park. Both towns are located in central Florida, a region characterized by a pleasantly subtropical climate during most of the year, many lakes, and abundant vegetation. Essentially, they were selected for study because census data indicated that they had high concentrations of people above the age of 60 and it was known that many retired people were inclined to settle there, thus making them almost natural laboratories for research on many gerontologic phenomena. When the rather sharp differences in their socio-economic makeup became apparent, furthermore, during the course of the study, it was believed that a consideration of some of the similarities and differences of the ways of life of the two groups might shed significant light on a number of problems. The present report should be regarded as preliminary to more detailed descriptions of the findings which are in preparation.

METHODS

An effort was made to gather the data in a controlled, systematic fashion. The procedure may be considered to have been in accordance with the following steps:

1. Construction of a schedule to be used as the basis for a personal interview with each subject.
2. Preparation of the communities for the project.
3. Sampling of the old age population of each community.
4. Selection and training of the interviewers.
5. Conducting of the interviews and recording of the data.

The schedule was developed and organized by I. L. Webber of the Florida State Improvement Commission and the writer. Liberal use was made of the reported experiences and suggestions of other workers such as McKain (2), Cavan and her associates (1), and Webber (3). The content included direct, indirect, and open-end questions designed to elicit biographic information about each individual, as well as reflections of some of his interests, attitudes, and activities. It was planned to have the interview last about forty minutes to an hour.

An important phase of the project was the development of rapport with the communities as a whole, so that the proper cooperation could be obtained when the data were to be gathered. Letters to the mayors and chambers of commerce served to introduce the project to them. These were followed by visits to the towns. In addition to meeting with the officials and business leaders, contacts were made with various active civic, religious, welfare, and educational workers who were acquainted with the aims and plans of the project. The radio and press were also informed of what was going on and news releases were prepared for them throughout the period of the field study.

Ten interviewers were chosen, 5 for each community, who were instructed in the procedures and techniques to be used in contacting and interviewing prospective subjects. All the interviewers were graduate students in clinical

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psychology or social work and had had extensive training and supervised experience in dealing with individuals in face to face relationships. An essential element of the instructions given the field workers was a stress on recording responses, in so far as possible, in the language of the subjects.

The relative smallness of each community made it possible to sample a fairly large percentage of the populations. In St. Cloud each fifth house was visited and all persons of 60 years and over were requested to cooperate with the project. The same procedure was followed in Winter Park, except that here every sixth house was visited. A total of 271 potential subjects was found in St. Cloud, but only 245, or 90.4 per cent (113 males and 132 females), could be interviewed, since 26 refused for reasons such as illness, lack of interest, and fear of talking about themselves. In Winter Park 172 subjects were found, of whom 141, or 82.6 per cent (62 males and 79 females), could be interviewed. St. Cloud is an all white community, but in Winter Park it was found convenient to interview only the non-Negro population. Later studies will attempt systematically to survey the Negro population also. Generally, all who participated directly in the project considered that both communities cooperated excellently.

General Background of Samples

If the number of subjects contacted in each community is a representative sample of the population aged 60 years and over, then it would seem that St. Cloud has about 43.9 per cent of its people and Winter Park has approximately 17 per cent of its citizens in that age category. Probably the latter figure should be somewhat higher since it was not possible to contact many older residents of Winter Park who are quite wealthy and move to their homes in the north during the summer, the period during which the study was conducted (the latter part of June, 1951). These figures contrast sharply with the approximate 10 per cent of people in the above 60 year group reported for the country as a whole.

The age range of the St. Cloud group was 60 to 104 years with an average of 72.9, while the Winter Park group ranged between 60 and 74, the average being 70.9. Sex differences were small, the males being, on the average, about a year older than the females. Neither group of subjects was essentially made up of people who had spent the major portion of their lives in Florida or even in the South. More than half in each case had lived in their present communities from a few months to ten years. On the other hand, only about 13 per cent of the St. Cloud sample and 5 per cent of the Winter Park group lived there more than 30 years. Prior to settling in these towns the great majority (75 per cent for St. Cloud and 66 per cent for Winter Park) resided in the northeastern and midwestern states north of Mississippi. Only about a fourth of each group came from the southeastern and south midwestern states. Generally also most of the people came from cities which are much larger than their present towns.

In economic circumstances the two samples are markedly different from each other. Most of the male and unmarried female population of the St. Cloud group (73.5 per cent and 60 per cent respectively) had monthly incomes ranging between $50 and $199. In addition, 8.9 per cent of the males and 31.4 per cent of the 70 unmarried females reported their incomes to be less than $50 per month. On the other hand, only 29.1 per cent of the males and 34.7 per cent of the unmarried 46 females of the Winter Park group had monthly incomes in the $50 to $199 range. Those who reported their incomes to be less than $50 per month included about the same proportions as were found in St. Cloud. Thus 85.8 per cent of the St. Cloud sample of old people indicated that their incomes were less than $200 per month, while 45.4 per cent of the Winter Park subjects indicated such incomes. As might be expected, there was a low percentage of St. Cloud old folks who reported incomes of $300 or more per month (1.8 per cent). But there was a sizable group in Winter Park who said they had such incomes (24.7 per cent).

The occupational makeup of both groups was considerably contrasting, as might be expected from the report on income levels. In St. Cloud only 27.3 per cent of those who had occupations (this excluded housewives and women who had never worked for an extended period) fell into professional, proprieter, and manager groups, whereas in Winter Park 58.4 per cent of the sample were in those categories. On the other hand, a large proportion of the St. Cloud sample indicated their occupations to have been in the craft, service, and labor groupings, but a relatively small portion of the Winter Park subjects had earned or were earning their livelihood in these areas.

Educational attainments were also very contrasting between the groups. More than a fourth of the males and about a fifth of the females of the St. Cloud group had less than an elementary school education, while this was the case with fewer than 10 per cent of the Winter Park sample. A fairly high proportion (48.7 per cent of the males and 56 per cent of the females) of the St. Cloud old folks indicated that their schooling was above the elementary school level. But the proportions in Winter Park were much greater (74.2 per cent of males and 75.9 per cent of females). It would seem, therefore, that both groups have been exposed to considerable education, but the Winter Park old age population is definitely ahead of the old people in St. Cloud. Perhaps this explains why only about a third of the men and women of the St. Cloud group indicated that they find it easy to learn things in which they are interested, while somewhat more than a half of the Winter Park group believed this way. On the other hand, reading is an activity on which the vast proportion of both groups reported they spend at least an hour or more per day. There may be, of course, and probably there are large differences between what the two groups read, but these data have not yet been tabulated from the interview materials.

Living Conditions and Activities

Marital Status and Housing: While a very high proportion of each group was married, the percentage of married men far exceeded that of the women. Thus, 80.5 per cent and 88.7 per cent of men in the St. Cloud and Winter Park samples respectively were married, but such was the case with only 57.6 per cent and 48.1 per cent of the women. On the other hand, there were merely 13.3 per cent and 8.1 per cent of widowed men in the St. Cloud and Winter Park samples respectively, while in the case of the women the figures were 31.1 and 39.2 per cent. Probably the oft-repeated finding that women in Western civilization have greater longevity than the men and the fact that men tend to marry women who are younger than themselves are but two of the possible reasons which may explain the above differences. It is, of course, quite apparent that relatively few of the individuals interviewed in both towns were single or divorced.

Almost all of the married old people who were interviewed in the two towns were living alone with a spouse. A fair proportion of individuals, 10.6 per cent of men and 25 per cent of women in St. Cloud and 6.5 per cent of men and 17.7 per cent of women in Winter Park, lived alone. The remainder made their homes among their children, relatives, or friends. Generally, the vast majority were pretty well cut off from personal contact with their families. About 70 per cent of the subjects indicated that they see relatives, other than those they may be living with, only very occasionally, and even less than once per year.

Housing space seems quite liberal and adequate for almost all of the people in both samples. More than three fourths of each group reported that they own their homes, and 76.7 per cent in St. Cloud and 79.6 per cent in Winter Park indicated that they live in seven or more rooms. Only 12.2 per cent in St. Cloud and 4.9 per cent in Winter Park said they had from one to four rooms. Furthermore, merely about 6 per cent of both

groups considered that their housing was not adequate. These data would seem to create the misleading impression that there is little or no difference in housing between the aged populations of the two communities. Actually, of course, there is a very pronounced difference in the quality of the homes of the two groups. The precise evaluations of the houses were not tabulated, but the subjective judgments of the workers on the research project who visited both towns were unanimous in regarding the homes in Winter Park as clearly reflecting the higher financial status of the residents.

Health: Despite the relatively high average age of the groups, the general health of the samples seemed quite good. More than 75 per cent of those interviewed in St. Cloud and over 90 per cent of those interviewed in Winter Park claimed that they were in fair, good, or excellent health. Over 90 per cent of the members of both groups indicated they had had either none or but a few sick days which kept them in bed during the previous six months. In addition, more than half the subjects in both groups reported that during the preceding half year they neither visited nor were visited by a physician. On the other hand, a small proportion in each group, about 5 to 15 per cent, required these services more than five times.

Social, Religious, and Leisure Time Activities: Such healthy people might be expected to have fairly active lives. Subjectively, this seemed to the writer to be the case. There seemed to be a large variety of clubs, church groups, recreational opportunities, and other social outlets available to all. Although a majority of the subjects reported that they had fewer friends now than about fifteen or twenty years ago, very few indicated that they were socially isolated. More than 50 per cent of both groups mentioned that they had "more than ten" or " many" friends with whom they had contact. In addition, more than 75 per cent in the two communities believed it was not hard for them to get on with people.

Lots of time seems available to these people, more than 75 per cent of both groups reporting they can do with their time as they please during the greater portion of the day. With this time most of them seem to be engaging in diverse activities. When asked to indicate the specific activities to which they devote their leisure time, from 30 to 55 per cent of each group checked seven or more activities. More than 70 per cent checked four or more activities. Among these, reading, radio listening, gardening, and card playing were popular among both the men and women. Sewing was checked very often by the women, while sports such as fishing and shuffleboard were frequently indicated by the men. It seems that these leisure time pursuits attract the people more than clubs and organizations. The majority reported they give less time now to social organizations than they did fifteen or twenty years ago, and about 60 to 70 per cent of both groups indicated they attend "none" or "less than one club meeting per month."

The church is of greater importance apparently to the old people of St. Cloud and Winter Park than organization meetings, but at least a quarter of the sample interviewed in each town indicated that they never attend services, and another 10 to 20 per cent said they attend less than once per month. About 30 to 40 per cent attend regularly, at least once or more per week and the remainder go about once per month. More than half the St. Cloud sample and about 44 per cent of the Winter Park group said they attend church less frequently now than fifteen or twenty years ago. The reason most often advanced for this was physical disability, but about 20 per cent mentioned they lacked interest.

The vast majority of people interviewed indicated they identified with the Protestant religion (about 84 per cent for St. Cloud and about 88 per cent for Winter Park). Catholics made up approximately 8 per cent of both groups and only 1 per cent indicated they were of the Jewish religion. Of interest perhaps is the fact that about 4 per cent in St. Cloud and about 2 per cent in Winter Park mentioned that they identified with no religion. Those who indicated their religious preference

as Protestant were divided among various denominations, the Baptist and Methodist churches in St. Cloud and the Congregational church in Winter Park being most popular.

Vocational Activities and Attitudes: In both communities the vast majority of those interviewed were retired, only about 5 per cent mentioning that they were still pursuing their regular occupations. Of the retired people in St. Cloud 12.7 per cent have engaged in full or part time employment since retirement. The reasons most frequently advanced for this were need for the money and a desire to be active. In Winter Park 28.2 per cent have worked since retirement. Few ascribed this to need for the money, but more than 60 per cent indicated that they liked to be active. Incidentally, almost all who were working mentioned that they enjoyed it and among those who were not working, about 30 per cent in each community responded that they would like to have some kind of job. Generally the desire was for part time work. Most, however, (about 65 per cent) who weren't employed responded "no" when asked whether they would like to find some suitable kind of work. On the other hand, in response to the question, "Do you think it is best for older people to continue working at least part time, even after the usual retirement age?," more than 75 per cent of each group responded "yes." It would seem, therefore, that the subjects believed that work was good for the next fellow's soul.

In regard to a suitable age for retirement there was a general lack of agreement among the subjects. About a fourth of each sample considered that 60 was a suitable age and about another fourth designated age 65. More than 45 per cent of the St. Cloud group said that people should never retire, if they can work, whereas only about 35 per cent of the Winter Park group believed that way. Significantly, a greater proportion of the women in each community than the men indicated that one should never retire. Agreement, on the other hand, was more general on the pace at which retirement should proceed. More than 60 per cent believed that it should be gradual, whereas about 30 per cent thought that it should be at once when retirement age arrives.

Political Interest: In both St. Cloud and Winter Park 85 to 90 per cent of the old age groups indicated that they were registered voters. Of the St. Cloud group 41.7 per cent responded that they were Democrats, while only about 28 per cent of the Winter Park sample identified with this party. On the other hand, approximately 35 per cent of the St. Cloud old people interviewed said they were Republicans, but more than 50 per cent of the Winter Park group mentioned such an affiliation. One can hardly help wondering whether this difference is in any way related to the socio-economic differences mentioned earlier between the two samples. Generally, however, the vast majority of the members of the samples regarded themselves as politically conservative.

Both groups apparently exercise their franchise. In response to the question as to whether they voted in the last presidential election, about three-fourths of each group indicated "yes." In the matter of a more active participation in political matters through communications with their representatives in Washington, however, few availed themselves of this privilege. More than 80 per cent never write and of the remainder, few write more than once per year.

Some Attitudes Toward Self: The subjects in both St. Cloud and Winter Park suggest by their responses that most of them are fairly contented people. Thus more than 90 per cent of the groups indicated that they felt at least reasonably well satisfied with what they had accomplished in life. For more than 75 per cent of the individuals life had been moderately or very happy, while only about 2 per cent reported life to have been unhappy. Most of the subjects believed their present lives were at least as happy as had been the case before they reached age 60. In addition, about 20 per cent thought their present lives to be happier.

A large proportion of the subjects claimed that they do not regard themselves as old

despite the fact that they are beyond 60 years of age. Thus in St. Cloud about 58 per cent indicated they did not feel old and about 85 per cent of the Winter Park group reported they believed similarly. Not many of either group expressed fear of old age, but about 35 to 40 per cent of the St. Cloud sample and about 30 to 35 per cent in the Winter Park group indicated some concern over being able to care for themselves during their later maturity. Of interest also is the response to the question inquiring whether they considered the period of old age to be one of freedom from worry. In the St. Cloud group there was an approximately even distribution of "yes" and "no" answers by both the men and women. The men and women of Winter Park, however, seemed to believe differently, 53.3 per cent of the men reporting that old age did mean freedom from worry for them, but only 38 per cent of the women thinking that way. Essentially, however, fairly large proportions of both groups regarded the later years of life as holding in store for them various concerns.

Summary

A survey was made of the living conditions and general adjustments of people 60 years and over in two Florida communities, St. Cloud and Winter Park, which have disproportionately large retired and elderly populations. Field workers visited every fifth dwelling in St. Cloud and every sixth one in Winter Park and interviewed the people, using a specially prepared schedule of questions. A total of 386 persons were interviewed, representing about 87 per cent of the potential subjects contacted. In Winter Park the sample was found to be of a definitely higher socio-economic status than the St. Cloud group. This was reflected in the former's relatively higher income, superior education, better quality homes, and occupations which carried greater prestige. The sample is, of course, of limited and incompletely defined scope, but the reported data may be regarded as throwing some light on how many elderly people of varied socio-economic levels live and adjust.

The following generalizations seem to be warranted from the data.

1. The similarities between the two contrasting socio-economic groups are far greater than the differences. Financial advantages enable the Winter Park group to live more comfortably, but their health, family status, attitudes, and ways of spending their time do not seem far removed from those of the St. Cloud group.

2. A sex difference in regard to marital status was found, a far greater percentage of men than women being married.

3. Housing space was found to be liberal for almost all and most indicated that they owned their homes.

4. Generally the elderly folks interviewed were in good health.

5. Leisure time was abundant since the majority was retired and did no regular work. They tended to be quite active, spending much time socializing with friends, and in such activities as reading, radio listening, card playing, and gardening. Sewing was popular with women and sports such as fishing and shuffleboard with men.

6. Interest in religion, judged by frequency of church attendance, seemed to be relatively mild.

7. The people interviewed generally regarded themselves as politically conservative, but the Winter Park group tended to affiliate with the Republican Party while the St. Cloud group chose the Democratic Party.

8. Attitudes toward life tended, on the whole, to be optimistic. The subjects did not seem to fear old age and contentment was expressed with past accomplishments. Many, however, showed concern over being able to care for themselves in the future.

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The project described is a phase of a larger research program sponsored by the Florida State Improvement Commission to gather significant data on the social, psychologic, and economic aspects of the old and retired population of Florida (4).

Acknowledgment is made to the many people who collaborated in the planning of the study and in the assembly and analysis of the data, especially Mr. Irving L. Webber of the Florida State Improvement Commission, Dr. William Leap, and Mr. Gordon Aldridge of the Florida State University School of Social Welfare.

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Jobs for Older Workers

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THE opportunities for regular gainful employment for older persons must be extended. Many different considerations are combining to impress us with the need for such action. There is a great demand that these persons be self-supporting. The nation needs their services. Many can participate productively in the community. With the growing number of older persons, the cost of maintaining an unproductive sector is becoming more staggering. The closing of the doors of industry to this formidable group in the population can only result in the formation of powerful political groups demanding remedies often at the price of the well-being of other sectors. A healthy economy therefore demands that we plan for their employment and absorption into productive occupations.

In the past we have relied upon informal procedure and haphazard improvisations to find jobs for these persons. There has been no recognition that there may be an alternative procedure of redesigning the jobs in industry to suit the characteristics of the older persons. To do both careful placement and to refashion the actual job requirements, it is imperative that we have a carefully developed list of principles with which to aid both the placement officer and the engineer developing the new jobs. Other current discussions are focused upon the problem of expanding our facilities and knowledge and stressing the opportunities for increasing the period of workers' full usefulness and delaying the onset of senescence. We believe that these approaches are important. But along with these activities closer studies must be made of the methods for extending the job opportunities for the older workers as we now know them.

The common tendency in discussions of employment problems of the older workers is to assume that jobs are fixed and invariable in their demands. The history of industry suggests a very different conclusion. Job patterns and the qualities required of workers have changed over the course of time. Industry has continuously adapted its jobs to the supply of labor. When there was an abundant supply of children and women, the factory system devised jobs suited to them. When child labor laws limited and prohibited the employment of children, jobs were redesigned for the utilization of adults. The rise in the supply of high-school and college trained persons is now prompting the development of jobs to employ such persons (2). The experience with the handicapped reinforces the conclusion that many persons now considered unemployable can be hired for highly productive and profitable jobs if attention is focused on adapting the jobs to the workers.

The increasing size of the older worker population presses hard on us and suggests the need of adapting a wider number of jobs for their special capacities. Knowledge of the basic guides to be followed in such job redesign may hasten the process and assure more constructive results.

Additional support for this positive approach is supplied by the experience during recent years with the utilization of older workers. We have found that the proportion of older workers in employment has increased with the rise in the level of employment. During periods of full employment, employers set aside their opposition and age-hiring rules and increase their recruitment of older workers. Many are directed to special jobs while others are placed on the regular lines of production. During World Wars I and II, many were hired

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who had actually already retired (3, 5). One essential element in the constructive program for the continued employment of older persons is national full employment.

New York State Study of Older Persons' Jobs

Several different approaches may be followed in defining the jobs for which older persons may be employed. The results of each must be summarized to make available to the engineers and placement officers more precise information on job possibilities for the older age groups. One source of knowledge is the analysis of the jobs at which these persons are now employed.

One such investigation was made in 1931 of 364,073 wage-earners in New York State manufacturing industries (1). This study analyzed the jobs at which these persons were employed in terms of job characteristics; it therefore provides specific insights (1). Some of the more outstanding findings may be summarized as follows:

1. Men and women of all age groups were employed on machine work which included jobs at which the worker either supplied the power for the machine, changed the direction or speed, or operated or fed the machine. Such machine work remained the most significant source of employment in the case of males in all but the most advanced aged groups and the most important one in all age groups for females (table 1). The proportion of men engaged in this class of work declined consistently after the age of 35 years and most sharply from 60 years of age and upwards. The proportion of women on such jobs in all age groups remained stable because of the particular importance of sewing operations in New York State industry (1).

Machine work does not therefore bar the employment of the older person but some types of work do present peculiar difficulties. In devising jobs for older persons it is important to minimize the types of work demanding direct speed in reactions, constancy of movements, concentrated attention, instantaneous coordination of faculties, and repetitive movements. Where these qualities are required, the job must be redesigned so that the actual work is performed mechanically or through electronic devices and the worker receives magnified or reinforced stimuli and is protected by stop motions and signals which reinforce his own awareness of the need for response. Machine tending, rather than machine operation, must be the goal. Fortunately, the trend is towards such jobs.

2. Body work jobs provided employment for an increasing proportion of workers with the rise in age. While 21.3 per cent of persons 30 to 34 years were on such jobs, the percentage was 37.5 per cent for those 70 years and over. Many older persons were employed on laboring jobs including janitorial and maintenance services and unskilled tasks.

3. Handworkers maintained a relatively stable proportion in all age groups until 60 years. The proportion then dropped slightly for the older age groups. A marked rise occurred with increasing age in the proportion of persons on clerical jobs. Older persons shifted to them either through advancement or transfers, as they often provided less strenuous employments.

4. Jobs requiring no training provided an increasingly more important proportion of opportunities for the older age groups. While only 15.3 per cent of the workers in the age group 30 to 34 years were on such jobs, the proportion for persons 70 years of age and over was 33.8 per cent. The unskilled or "older man's jobs" became a refuge for many survivors in industry. The tendency was most marked among men.

5. Older persons were least secure on jobs requiring some, but less than four months' training. For these jobs, employers tended to prefer younger persons who would quickly acquire the new performance patterns. A similar tendency was noted in the intermediate group of jobs requiring from 4 to 18 months' training. The proportion of workers on these two grades of jobs declined with advancing

TABLE 1. CLASSES OF OCCUPATION EMPLOYING 50 PER CENT OF WORKERS OF EACH SEX IN MANUFACTURING INDUSTRIES OF NEW YORK STATE BY INDIVIDUAL AGE GROUPS BEYOND 39 YEARS (UNWEIGHTED SUMMARY)

Occupation and Sex	40–44 Years		45–49 Years		50–54 Years		55–59 Years		60–64 Years		65–69 Years		70 and Over	
	Percentage of age group at occupation	Rank of occupation	Percentage of age group at occupation	Rank of occupation	Percentage of age group at occupation	Rank of occupation	Percentage of age group at occupation	Rank of occupation	Percentage of age group at occupation	Rank of occupation	Percentage of age group at occupation	Rank of occupation	Percentage of age group at occupation	Rank of occupation
MALES														
Hand, medium, 18 months or more	13.91	1	14.32	1	14.68	1	13.96	1	13.62	1	13.11	1	11.84	2
Machine, medium, 18 months or more	10.41	2	10.38	2	9.52	2	9.36	3	7.97	4	7.96	4	....	...
Body, great, no training	9.49	3	9.67	3	8.80	3	9.74	2	10.21	2	9.36	3	8.32	4
Machine, medium, less than 4 months	8.68	4	8.17	4	8.01	4	7.69	5	7.23	5	7.66	5	6.94	5
Machine, medium, 4 to 18 months	7.61	5	7.36	5	....	..	....	..	....	..	....	..	....	...
Body, medium, no training	....	..	....	..	7.25	5	8.26	4	9.64	3	11.70	2	13.32	1
Body, slight, no training	....	..	....	..	....	..	....	..	....	..	....	..	9.14	3
All others	49.70	..	50.10	..	51.74	..	50.09	..	51.23	..	50.21	..	50.44	...
FEMALES														
Machine, slight, less than 4 months	22.34	1	20.95	1	18.83	1	20.83	1	19.73	2	22.86	1	19.20	2
Machine, moderate, less than 4 months	14.20	2	15.85	2	17.58	2	19.02	2	25.24	1	21.43	2	20.80	1
Hand, moderate, less than 4 months	11.16	3	10.92	4	9.45	4	11.43	4	7.97	4	9.29	4	7.20	4
Hand, slight, less than 4 months	10.90	4	11.37	3	13.42	3	12.40	3	13.85	3	18.21	3	15.20	3
All other occupations	41.40	..	40.91	..	40.72	..	36.32	..	33.21	..	28.31	..	37.60	...

age from the peak attained in the 30 year age group. As would be expected the proportion of persons on the very skilled jobs requiring 18 months or more of training rose through the age of 49 years. Beyond 50 years, the percentage dwindled slowly but steadily.

While older persons therefore had an advantage on the highly skilled jobs, the rapid rate of technologic developments is scrapping past skills and reducing the value of the asset. The tendency to increase the number of jobs in industry requiring rapid training in new skills suggests that training and job transfer practices must be better adapted to the peculiarities of the older person. They are now inadequate.

6. The older persons tend to drop out of the very strenuous jobs. They shift to the lighter jobs rather than to those calling for medium physical exertion. The increased number of materials handling devices and careful job lay-out and machine design can do much to lighten jobs in industry.

7. On the overall, jobs requiring medium physical exertion and calling for 18 months or more of training provided the most impor-

tant single source of employment for men in all older age brackets, except the very last of 70 years and over. Machine work jobs calling for medium physical exertion tended to drop in importance with rising age. Body work jobs expanded in their relative importance with the aging work force. While jobs calling for medium physical exertion and no training occupied fifth place as a supplier of jobs in the 50 to 54 age groups, they jumped to first place in the 70 years and over age group.

8. Among women, the relative importance of different classes of work was much more constant through the age groups, in part because of the predominance of such work as machine sewing and hand assembly. Four types of occupations furnished approximately 60 per cent of all jobs for women 40 years and over. Machine work requiring less than four months' training was in first and second place in all age groups. In third and fourth place were hand work of similar training requirements.

Jobs can be redesigned to stress the qualities best adapted to the successful employment of older persons.

The Nuffield Research Studies

A more recent analysis of jobs held by older workers (the Nuffield Research Unit into Problems of Ageing) covered 3,221 employees on 95 operations. Their conclusion was that "older people tended to be found doing work where there was an absence of time-stress—in other words, work which could be done at their own pace, unhurried by pressure for speed, and where there was opportunity for accuracy to be displayed to advantage. There was a tendency for operations on which the numbers were small to have a relatively high proportion of older people. Among such classes of work as machine-feeding, machine operating, light assembly, heavy work, and inspection, older people were not found on one more than another, except in so far as the classes varied in the proportion of operations they contained on which time-stresses were present . . . Older people can maintain an established skill to an age considerably beyond that at which they can without undue difficulty learn a new skill . . ." (4).

The same institution has also conducted laboratory investigations to develop a theoretic basis for understanding the behavior of older persons. Some of their preliminary conclusions are that older people can handle a series of moderately heavy tasks so long as they are not constant; that they can perform satisfactorily jobs demanding high degrees of accuracy; that skills can be more easily maintained than acquired in old age.

Summary

Jobs are available in American industry for the growing proportion of older workers. These persons can be as productive as our present work force. The primary requirement is that management acquire more knowledge of the methods of redesigning jobs so that the full potentiality of the older worker may be maintained. Many current trends in industrial management, such as increased mechanization of operations, expansion of machine tending jobs, improved plant lay-outs, new machine designs, and abundant automatic methods for materials handling, improve the opportunities for employing older persons. More incisive research will help describe the older workers' jobs more carefully and help management in this undertaking.

The redesigning of jobs for the employment of older persons is imperative. Organized labor, the public, and our economy demand it. Effective advances in this field will also help many European nations who have large older populations.

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The Philadelphia Story in Geriatrics

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The Current Picture

Attention to particular segments of an urban population is attracted by unusual rather than routine circumstance. A group may be so vocal, dangerous, pathetic, or just so big that it gets a high place on the list of civic planning. A picture of a child in a slum, an editorial on narcotic addiction, an appeal for cerebral palsy—these are the methods of obtaining responses. The older fraction of society finally has gained its protagonists. This must be due in part to their greater numbers since their needs have not changed.

Philadelphia has a background similar to most large cities in the considerations of its older age citizens. Those who become public charges may be sent to the County Home for the Indigent where individuals with physical, mental, and economic problems have of necessity been housed indiscriminately. A limited number are in adequate old age homes, often church-supported on sectarian lines. Occasionally, high age and low economic status lead them into mental institutions almost as accidents of public management. In one mental institution in Pennsylvania, one-third of the older patients are not psychotic; they are merely old and economically inept.

Some fraternal orders and various charities have established housing refuges. Persons of sub-basic means manage to survive somehow in sub-marginal boarding houses, some of which have, and others aspire to, the status of nursing homes. Others have no such pretensions, being commercial ventures filling a need in a manner which a city would like to forget. Only publicity, application of housing laws, licensure,* and supervision by the State Welfare Department keep such places from complete disgrace.

These are some of the accessory living aids of those older persons who have had to resort to family-substitute agencies. There are indications that the future will be different. Plans for fortifying private living, rather than increased institutional care, is the city's major goal.

Trends

During the 1930's, a vague but general change began to occur, motivated by many community forces. Responsible persons and groups directed their efforts into these new channels. The medical profession was beginning to hear of a division of medicine labelled geriatrics. The Pennsylvania State Medical Society in its 1938 annual meeting had its first scheduled paper on the Status of Geriatrics. This was followed shortly by a symposium on the subject by the Philadelphia County Medical Society. A new word (even though not necessarily a happy invention) had entered the medical vocabulary.

At the time that the sulfonamides seemed to promise specific control of infection, the needs and numbers of older persons suddenly seemed greater, although the two points are related only historically. The Health and Welfare Council of Delaware, Montgomery, and Philadelphia Counties created a Division for the Aged in 1943. Social workers were quick to see and to respond to their changing rosters, the rolls of which contained possibly fewer neglected children and certainly more neglected persons of high years. Hospital populations were changing. Fever wards and contagious disease hospitals were being altered for long-term care.

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Social security with old age and other special types of financial aid had become an accepted part of federal budget and planning. Formalizing and giving direction to the national movement were personalities, many but not all of whom were medically trained. At the time that the American Geriatrics Society had formed and the Gerontological Society was being planned, clinics and medical courses had been started in Philadelphia (1943).

These are some of the preliminaries in a city which matched national progress, and, with occasional exception, were neither much ahead of nor much behind the average.

Social Aspects

Theoretic and practical considerations of the older group at the clinical level were being surpassed by sociologic measures. Generally, the social welfare method is subsidized and budgeted, directed by salaried full-time workers whose training tends to categoric lines of social needs. The value of these categories is in the application of an informed, capable force to specific problems with the maintenance of individualization in the general pattern of efficient administration.

The older type of welfare effort, voluntary, unpaid, and dependent on donated time and money, continues as a factor. This volitional work is a highly essential adjunct to the professional social service framework. It has been molded by intelligent action into an adaptable and mobile force.

Clinical Efforts

Meanwhile organized clinical effort lagged. With exceptions, it had been retarded by persistence of the idea that demarcation of a field of special study about the older body was unnecessary.

Geriatrics is adapted to the full pattern of living; it cannot be limited to the practical problems of clinical medicine alone. Starting with diagnosis and effective treatment up to restoration to normal activity, it is natural to consider nutrition, housing and recreation, employment, finances, and all other phases in the total care of the older individual. The task of the physician cannot be restricted to the medical aspect alone since health in the higher years is closer to the full scope of life than in youth with its extra margins of safety.

To medical students, the sick population has a different look than it had in their teachers' formative period. The drama of hopelessness in the common acute and uncontrolled states of infection is a twice-told clinical tale. Fever wards in which medical fame was achieved by the description of a physical sign are a generation distant. In contrast, the profession is confronted constantly with rows of cardiac, hemiplegic, orthopedic, and debilitated older persons. The infrequent classical infection is exhibited pointedly for didactic discussions because it may not be seen soon again in a career in medicine—but the depressing wards of older persons are bigger and fuller.

The very effective anti-infective agents are accepted as routine by the clinician who handles problems of the older body primarily. Spared premature terminus from infections, there is a lengthening life to be lived with a longer potential for accumulative disorders. These disorders include the results of immunologic adjustments, physiologic vagaries weaving into and out of clinically recognizable pathologic conditions, and biochemical adjustments of the older body's equilibrium. They require more of the physician than the decision of which antibiotic to use. The frontier roughness of specific febrile states is being replaced by the investigation of those chemical modifications which demarcate with sublety the metabolic stages of life.

The Basis for the New Science

The patterns of chronic disease are the headlines of modern medicine. In those countries where infections and infestations are common and social solutions wanting, the average life span is less than thirty years. As the cultural scale improves, there is an associated improvement in technical medical application. Average

duration of life rises. Cycles of change in clinical medicine are initiated by many things; new therapeutic agents and new adaptations of physiologic principles are recognized forces. Less obvious but of equal importance are better housing, improved nutritional standards, effective health programs, and social benefits extended to an increasing proportion of the population by state assistance when there are economic inadequacies.

It has been suggested that the older fraction of society be managed in a medical manner different from other age groups. This proposal must be regarded with extreme caution. The sound trend is towards adequate individual care bolstered when needed by pensions, social benefits, voluntary health plans, accessory diagnostic clinics, insurance, public assistance, as well as private resources. Defects are being remedied in a mature development that is in harmony with, rather than foreign to, the remainder of the civic scene.

Having a large physician population, major teaching centers, a moderate fee scale, and adequate support of public health improvements, Philadelphia's progress has been one of general but rarely mutational character.

The Active Agencies in the Problem

Geriatric needs have merged with the conservative pattern of the city's medical life.

Those social defects relative to the 172,000 Philadelphians over 65 years of age in a city of more than two million are of a kind familiar to every city. There is a lag between gross need and detailed response. The former are apparent and the responses are being formulated.

Medical Schools

Personally accumulated medical experiences rather than formalized instruction have been the usual source of individual clinical information. The several teaching courses are limited and short of the needs of students who require this type of instruction. Organized rosters are in flux. The teaching is diverse because curricula reflect professional thinking which may or may not match social essentials. The courses generally are personal efforts rather than major solutions. These didactic influences, however, have been effective in pointing out the particular clinical aspects of the older body in the general program of medical instruction. The radical reformation of teaching programs requiring exposition of clinical principles of the older body based on physiologic fundamentals has occurred rather sporadically. Persistence in such limitations may be the cause of losing contact with the demographic pattern.

Nursing Training Schools

Several nursing training schools have instituted special forms of instruction. Student nurses are being taught the patterns of older age—the significance of the slight elevation of temperature, of the swollen pallid leg, the nocturnal restlessness, the rising respiratory rate, and the compulsions which in high age may be the cloak for emotional needs. The nurse is a bridge to essential geriatric care. Hers is the life in hospitals which have more beds occupied by more older persons for longer periods of time and with an increasing frequency of certain conditions and complications. She can almost compensate for the many inadequacies in the care of her older patients, although she should not be required to carry so much of the burden.

Clinics

The geriatric clinics have completed a decade of modest activity. One type of clinic is in a general teaching hospital and the other is private. This matches future needs, namely, 1) the clinic designed along investigational lines and 2) the clinic serving a special population group. The general medical clinic cannot be stratified according to age. It would tend to become an overflow center for older patients. Its roster would contain those patients whose interesting diagnostic wool had been sheared elsewhere, leaving only a fringe of confused older persons shepherded by an

assigned clinic physician. However, geriatric clinics can continue to be operated within special facilities for older persons such as pensioners' groups or old age homes without distorting the general clinic plan. These are functional units compared with the research type of clinic maintained in general hospitals.

The term *Geriatrics* must not be used as a respectable synonym for *senility,* a distinction which would be emphasized by the special clinic. Another aim should be the enforcement of the concept that a profession which has been trained in the ideal of *absolute* cure must be matured in the concept of maintaining relative physiologic balance. In older persons a cure may be only a stage between pathologic states. Both types of geriatric clinics must recognize this pragmatic distinction in medical management.

County Medical Society

One of the developments in Philadelphia has been the creation of a committee on geriatrics by the county medical society of approximately 3300 members. This recognition presages a major rise in interest by one of the nation's large organized civic medical groups. The leadership and planning necessary to the metropolitan area should accelerate the general municipal approach to the problems of its older citizens.

The committee aims are revealed by the disparity between high social service accomplishments and moderate clinical accomplishments.

Its goal will be "to define the clinical aspects of the higher years; to view the medical considerations of the ageing body in terms of its own physiologic dominants; and to establish an association with those agencies working in the other aspects of the individual's life. These are his social, economic, recreational, educational, and occupational needs. More than any other field of special interest, geriatrics sees the patient in a relationship indistinguishable from his background."

Health, Welfare, and Recreational Agencies

Social service departments of hospitals have been the shock troops for older patients. They have cooperated with medical health officers, departments of public assistance, visiting nurses, and various regional community groups, as well as medical schools. Their effective efforts have softened the urgency of the general inadequacy.

Individual agencies have done pioneer work. Lacking essential clinical guidance and being forced to improvise, they have developed their own plans for current and projected needs.

The Philadelphia Health and Welfare Council, a planning agency, has a division for the higher age group with a full-time effective consultant. In cooperation with the city's health facilities and financed by community funds, it is a focal advisory, technical, creative planning, and statistical center. It has studied needs and suggested methods on every plane from health to social legislation. It has pointed out the weaknesses of certain domiciliary arrangements for the aging and has encouraged improvements in licensing and in licensed nursing homes. The Division for the Aged has 53 participating agencies through which it has promoted a program for the benefit of the entire older age population.

The activities of the Philadelphia Recreation Association were associated in a plan of cooperation with those of the Health and Welfare Council's Education-Recreation Division in 1951. The former began as the Playgrounds Association of Philadelphia in 1907, privately financed and interested primarily in the location and supervision of children's playgrounds. In 1946, it became the Philadelphia Recreation Association undertaking the Health and Welfare Council's suggestion of a project of recreational services for older persons.

Its aims and financing typify civic changes in forty years, from children's playgrounds originally privately financed to community-supported higher age recreational needs. This has served as a national example of a well-

conceived, well-managed, and imaginative response to one aspect of older citizens' needs. Its 83 (December, 1951) or more classes and groups in Southeastern Pennsylvania are manned by almost 500 volunteers in a professional structure. It has been a bright light on the Philadelphia scene and its association with the Council should increase mutual values.

The Jewish Family Service has a total social plan consisting of maintained home care for older persons when possible and domiciliary arrangements when necessary. Supporting these opposites are homemaker and domestic services, social counselling, and financial aid. Foster home placement is being studied as an auxiliary to the general measures.

The Philadelphia Planning Commission has a Technical Advisory Committee on Health which has studied considerations of Philadelphia's aging population as a whole. The following recommendations were made to it:

1) That consideration be given to establishing a gerontology division in the Philadelphia General Hospital.
2) That public health centers plan space and personnel facilities for the regional aging population.
3) That the hospital and health center plan be supplemented by a complete home-care program.

There are also the traditional and rather effective supplement measures. The customary religious homes for the aged, often in close proximity to sectarian hospitals, are good examples. The work of the Society of Friends, although involving few in numbers in its boarding homes, is high in quality. The Philadelphia Shut-In Society attempts to ease the home situation of handicapped persons 18 to 65 years of age, promoting economic self-support at the individual's level rather than on an industry's time-schedule. (Its age limits need to be raised.) This society has a workshop at its headquarters employing 25 handicapped persons. The Visiting Nurse Society was selected by the Council as a coordinator for a complete home program which includes nursing, rehabilitation, and home-maker features attempting to utilize the full potentialities of the home environment and to reduce the demands on public resources. One geographic division of the city, Germantown, has this local plan of home care and accessory services directed by the Visiting Nurse Society to promote a pattern of normal living.

The state program of rehabilitation promotes purposeful living. It aims generally at economic independence through employability based on all possible physical assets. If combined with a home-care program which must include those of higher years, it could strengthen human potentialities regardless of the need or desire for an occupation.

Many commercially-operated homes are planned as licensed domiciles rather than as therapeutic centers. There has been an effort to improve the conditions of some of these boarding homes, some of which have been subterfuges for efficient older age care; others have been conscientious, supervised, and effective private establishments. The disclosures of some defects were sterile because the needs surpassed the solutions, and the vacuum had to be filled. The occasional independent, endowed, and supported home for the aged is in the best tradition, and eases the withdrawal from active community life.

General housing considerations for the aging are just reaching the discussion stage in this city and there are indications of some planning. These plans will of necessity follow the national pattern of need molded by essential legal adaptations.

An ideal gerontologic unit would be part of the answer to the problems of this growing fraction of the population in Philadelphia. This center should have certain characteristics. If possible, the physical plant should be in propinquity to a general hospital. Its construction should be in accord with its several purposes, having sections for the various forms of illness, including sections for the long-term ill and impaired as well as for terminal care.

The clinical activities should be under the direction of a medical administrator who would supervise an interne and resident program rotating from the general hospital.

The unit should be the physical and subexecutive center for all of the attendant social agencies. It should be a focal area for public health lectures, nutrition instruction, legal advisory service relative to the needs of the higher years, and it might supervise or possibly house that Community Public Health Service Area's health and recreation center for its older members.

The unit should offer in-patient and outpatient services with regular diagnostic and therapeutic clinics. It should foster medical and other types of conferences as well as a formal schedule of teaching for the staff and students of affiliated medical and nursing schools. Programs for the training of medical practitioners in the city should be available and publicized through the county medical society. It should be a research center utilizing private, public health, and other sources of funds.

The unit should have means to be able to transport its attendant patients to its clinics. It should be a focal area for utilizing state funds under the rehabilitation program geared to health rather than employment.

The staff should be assigned to in-patients, to those able to come to clinics, and should be enabled to extend its efforts through chiefs, fellows, residents, internes, and medical students directly into the private home.

This center should be an integral part of the home-maker and economic-aid programs, encouraging public exhibitions, lectures, fund-raising, and all incentives that will promote private living.

The regional health centers planned in Philadelphia must be semi-autonomous agencies between a peripheral home-care program and the major central gerontologic unit. From the outset, they should utilize some of their resources for the aging population of the serviced area.

Inasmuch as there can never be adequate public facilities for all potential community members, a proper home-care program is the natural goal for any scheme. In the last analysis, the private home is the best geriatric center. Social facsimiles, such as foster homes for the aging and varieties of institutional care, are substitutive agencies. The central gerontologic unit can support, facilitate, and direct a program involving many out-patients for each in-patient. A hundred candidates stand behind each of its occupied beds.

This comprehensive municipal arrangement ultimately would be economical in financial and human terms. Being almost inevitable, it should have proponents now before new buildings of the old type reduce the likelihood of inception in this generation. Even custodial homes can be realigned to serve as small centers for a city area, duplicating for one group or zone what a city-wide scheme could do for its entire older population.

Summary

Philadelphia reflects the slow organization of thought and action concerning its older age population which is occurring nationally. Agencies and plans are active in many parts of the municipal structure. Clinical and social cohesion has yet to be established. The needs of the higher years cannot be filed among the unsolved civic problems. They must be met as preparation for every man's potential future.

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A Note on the Meaning of Aging

ALBERT R. CHANDLER

At the recent Congress in St. Louis there was a panel discussion on the meaning of aging. In spite of the distinguished abilities and broad backgrounds of the participants, many of their auditors came away with a feeling of confusion.

Perhaps it would help if we separated two questions that seemed to be interwoven in the discussion. Assuming that "aging" is the label for the field in which we as gerontologists are interested, one question is, what is the most practical way to indicate the boundaries of this field? Let us call the answer to this question a definition of type A. Another question is, how may we concisely describe the basic features of aging and being old? The answer to this question would be a definition of type B. Confusion arises if we try to make one definition answer both questions.

A definition of type A belongs at the beginning of our inquiry, serving to mark out a field of common interest. It might well be a theme for committee discussion and recommendation in the near future. A definition of type B belongs at the end of our inquiry—if such an inquiry ever has an end. At any rate, it belongs to a more mature stage of inquiry than gerontology has yet reached.

Richard Robinson has written a useful book called *Definition* (Oxford University Press, 1950). In it he distinguishes lexical and stipulative definition. A lexical definition records "the actual way in which some actual word has been used by some actual persons." A dictionary gives definitions of this type (page 35). A stipulative definition is one in which some one proposes that a certain word shall be used in a certain way. When a mathematician writes, "By a denumerable series we shall mean" so and so, he is setting up a stipulative definition (page 59).

If we as gerontologists wish to clear up the confusion about various meanings of the word aging, and to indicate in a practical way the boundaries of our field, we might do so by agreeing that *for us aging shall mean so and so*. Our type A definition would thus be a stipulative definition. On the other hand we cannot afford to disregard lexical definitions altogether. In stipulative definitions it is unwise to deviate too far from current usage, for fear of deceiving or confusing our readers. For instance it would be unwise to define aging so broadly that it could be said, "Aging begins at birth." In ordinary usage aging means "getting old," that is, getting into a condition characteristic of the later years of life.

As a matter of fact, gerontologists are directly and primarily interested in phenomena of the later years. But if these phenomena have their *causes* in earlier years, the gerontologist will seek to trace these relationships. Again, if the cell structure of the placenta is "senile" at the time of birth, and if in some cases the thymus gland is absorbed in early years, the gerontologist will be interested in these phenomena as *analogues* of phenomena in the later years. A tentative definition of type A might be "the biologic, psychologic, and social phenomena of the later years of life, together with their causes and analogues in earlier years."

To produce a definition of type B that would summarize the basic features of aging and being old, we should like to know many things. We should like to disentangle the processes of "normal" aging from the effects of various diseases. To do so we need to study the life histories of persons as free as possible from disease and compare them with the histories of victims of various diseases. We should like to know the frequency and rate of many anatomic, physiologic, and psychologic changes and their intercorrelations. We should like to know the correlation of such changes with various types of accident and disease; also with

such social phenomena as retirement, social contacts, leisure activities, bereavement, etc. Ultimately, the use of factorial analysis might help us to draw a coherent picture of the interconnected processes of aging. We dare not *assume* that there is any one master-process; the degree of each interconnection must be established by research.

In the meantime it is inevitable that aging should present different pictures to physicians, psychiatrists, social workers, other professional men, and laymen. All of us are influenced by culturally determined prejudices and by observation of the few people we know best. It is desirable that gerontologists of different backgrounds should broaden their views by learning from one another. It is permissible that those who have the courage should offer generalizations on the basic nature of aging. These might constitute a definition of type B. But it is proper that these generalizations should be offered and received, not as ultimate conclusions, but as hints and hypotheses for further research.

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Aging of the Nervous System

Problem Identification

Second International Gerontological Congress and Fourth Annual Scientific Meeting of the Gerontological Society, Inc.

Monday Afternoon, September 10, 1951

Participants: A. Kuntz, *Chairman,* St. Louis, Missouri

J. L. O'Leary, St. Louis, Missouri

J. W. Papez, Columbus, Ohio

J. M. Sosa, Montevideo, Uruguay

L. J. Thompson, Winston Salem, North Carolina

EDITED BY A. KUNTZ

CHAIRMAN KUNTZ: In this matter of problem identification we must consider the question of technique and the study of other factors that may play a role in aging of the nervous system. Such problems may occur to some of you. I have noted a few.

The one that I would list in the first order was proposed by Dr. W. F. Windle: the importance of controlled fixing and staining in cytologic studies of age changes in the brain. I had expected that Dr. Windle would lead off in the discussion of this subject. He may be coming in a little later.

Another very important problem was mentioned in the forenoon session. It is the problem of securing suitable animals for the study of age changes and the importance of maintaining colonies of small animals, such as guinea pigs and rats, with a continuous supply of animals of all ages, so that animals of any desired age, from birth to senility, could be obtained at any time. That may present no serious problem so far as small animals are concerned, such as guinea pigs and rats.

The problem is more serious with reference to cats, dogs, and other mammals, because they live longer. We have had some experience in trying to obtain a series of dogs from youth to senility during the past six months. It was not a simple matter. If one were to undertake to secure a series of cats from birth to senility, it would be still more difficult.

I have no particular preference for any of these problems nor the order in which they shall be taken up. There may be other problems that occur to some of you. We should be glad to have your suggestions regarding what problems might be most important. What is your desire? Has any one any preference as to the first problem for discussion?

Dr. Papez, could we get you to express yourself regarding the importance of maintaining animal colonies of all ages?

DR. J. W. PAPEZ: We have found inclusion bodies in brain cells and tried to culture them in animals. In our transmission experiments we worked with the Parke Davis people, who used chick embryos, mice, and guinea pigs, for inoculations. We supplied them with brain material from living patients. They performed these injections and used brain suspension injected into the brain or intraventricularly.

We made something like 85 or more experiments. They gave fairly good histologic results; but in other respects were not altogether satisfactory, because we were interested in the transmission of specific organisms that we thought we had identified in the nerve cells of mentally ill patients. Guinea pigs were particularly resistant to successful inoculation. I think we had only about 11 per cent success in recovering the organisms in these animals. A small number developed paralysis.

We, in some cases, identified the inclusion bodies in the animal's brain. Frequently we found them in the kidney. The kidney tubule was the most common place for reproduction of the inclusion bodies in the guinea pig. In the mouse, however, the inclusion bodies appeared in considerable abundance in the liver. The spleen almost always reacted in both guinea pigs and mice. The chick embryos were generally negative.

I do not know exactly what animal should be used for studying the aging process. I have not been

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giving attention to this problem. I have been giving attention to the mental disease aspect of the problem as seen in the aged.

While I am on my feet, I might suggest that we need correlation of about five points in neuropathology. We have, for example, the Golgi network, as described by Dr. Sosa. That should be integrated with the other problem, especially that of lipofuscin granules. The fatty substances which we deal with also need integration with other material on adrenal cortical steroids. Then there is the case of pigmentation which occurs in the nerve cells, and finally the inclusion bodies which occur as lipofuscin granules. So we have at least four or five items which need to be clarified and somehow or other explained in terms of their actual origin and interrelations.

Then we need to get some dark contrast phase microscope results and compare them with photographs obtained from electron microscopy. I would urge those interested in this to actually use the phase microscope to identify some of the things in the brain which I am trying to present against a great deal of inertia. Very few people are interested in the animal zoology that exists in the brain, although I can assure you that it is of tremendous importance. I think all of these things can be integrated into some definite pattern. I believe there is a pattern in the process, and it is not all accident. We are dealing with the reactions of cells and with the growth reactions and survival of something else within the nervous system.

DR. J. L. O'LEARY: Dr. Kuntz, the problem is aging in the nervous system and trying to get a coordinated animal. I think more is known about the rodent's brain than the extent of psychoelectronics from the fact that you can select several rodents, all of whose brains are about equally well known, so that one is not restricted to a single species such as the mouse, the rabbit, or the rat. With the general homologies that can be drawn, the fact that psychoelectronic studies can be transferred from one rodent to another seems to me to make that an ideal class.

CHAIRMAN KUNTZ: May we have discussion from anyone else?

We have attempted during the past year to secure a series of rats from youth to senility. It is easy enough to obtain rats up to 300 or 350 days from dealers. When you want an integrated series beyond that age, and particularly approaching senility, they say, "We do not keep them in stock. We do not keep the old animals." What can we do to make the older animals available?

DR. L. J. THOMPSON: Dr. Kuntz, we have placed emphasis here on animal experimentation. If we consider subjects like arteriosclerosis and cerebral arteriosclerosis, I think a great deal of light has been thrown on causes by clinical studies of human beings. Mine was the only clinical paper presented this afternoon. Its purpose is to enter the plea that we try to experiment, let us say, on human beings that are showing definite signs of brain atrophy.

I would point out that we have been fortunate in having a grant by which we are setting up a separate geriatric unit. This grant came through the fact that we had a patient with Simmonds' disease. In this special unit we intend to carry out as much research as possible, but we should be depending a great deal on the histologist and the people who know about biochemistry and any other fields that are not strictly clinical. I think it will be by a combination of applying what you people discover—I say "you people" because it seems mostly there are people representing the biologic sciences here—and that which the clinicians can produce in human beings that we shall really clinch things.

CHAIRMAN KUNTZ: Your work is on the living subject and does not interfere much with the life or happiness of an individual. Histologic work is another matter.

It seems to me that Dr. Papez has been most fortunate in that he has been studying the brains of his friends. Who could have a better record of the history of the individual than one can have under those conditions? One of the difficulties, as far as human material for histologic studies is concerned, is the fact that you do not have it until an autopsy has been performed, and the autopsy frequently is not performed until a good many hours after death. When one uses that material, as I have had to do, the objection is always raised, "What have been the postmorten changes?" We cannot always tell what changes have taken place since death.

We have been fortunate in working in close contact with surgeons in the study of autonomic ganglia, so that we could fix the material just as soon as it was removed surgically. We have obtained a good deal of material of that kind, but one does not often have a chance to obtain parts of a brain under similar conditions.

It seems to me that we are leading up to the problem of the significance of early fixation of tissue, whether it is obtained from human subjects or from animals. Some of you probably have had experience in noting some of the changes that take place after death, whether they be in a few hours or in a day or two. Who can give us some?

DR. O'LEARY: Dr. Kuntz, I recently had occasion to review some of the literature on brains of patients with senile dementia and cerebral and psychotic changes in a group of very old humans studied by Drs. Gries and Voss. I believe their conclusions were to the effect that they could find no absolute direct correlation between the amount of neurologic or psychiatric change and the status of the brain. In one case I remember a 111 year old

individual who died of senile dementia of twenty-five years' duration had a better brain from the histologic standpoint than one who died at a much earlier age.

That brings up the point that in this type of work, if we are to proceed apace, it is necessary to have some animal that is fairly rigidly standardized, in which the age changes are known, and which can then be subjected to experimental variation. That possibility, I think, with histologic control, is very unlikely in the central neurons.

While I am on my feet, I want to put in a plug for the silver methods, which sometimes give very good results in the aged brain. They should be studied much more extensively.

DR. PAPEZ: In the human specimens that I have studied—about 80 in all—which were taken directly from the brain by the surgeons, I don't believe more than five minutes elapsed from the time of their removal to fixation; perhaps less time in most cases. In those which were taken several hours post mortem, I could see very little difference from the normal material, provided the post mortem material was not removed too late.

Fixation by perfusion of the brain is required. It is a surprising thing to me that so many men insist on the so-called early postmortem changes being rather deleterious so far as histologic techniques are concerned when such changes do not actually show up when the brain is fixed by perfusion immediately after it is removed. If, at the time of autopsy, a cannula is introduced into one of the arteries and the brain is perfused for thirty minutes or even less time, the brain will be relatively well fixed.

Of course, if the brain is only submerged into even strong formaldehyde, it may be several days before the center or the thalamus is reached by the fluid, as well as many other places which are inaccessible, and much decomposition will occur. But the fixation of the brain by perfusion through a suitable cannula and by the gravity method is an extraordinarily important requirement for good fixation. We use the gravity method, and that gives us pretty good results if we are early in getting the brain out of the cadaver.

CHAIRMAN KUNTZ: Are there any further comments? Can anyone contribute anything further to this particular problem?

There are, of course, certain methods of study in which postmortem changes do not make much difference. I think in general when one is using silver techniques the difference between very fresh material and material that has been dead for some hours may not be very great. For histochemical studies, it probably is very much more important to have the material fixed as early as possible.

One of the problems that has been suggested is circulatory impairment as a factor in aging of the nerve tissue. That might apply to changes in the brain as well as in peripheral nerves. In studying autonomic ganglia, we frequently find that there is some arteriosclerosis, so that the small vessels (particularly the small arteries in the ganglia) are partially occluded. The ganglion cells in such ganglia are very poor in chromidial substance and show other changes which suggest depletion of the cell. One gets the impression from studying sections of that kind that if the circulation through a ganglion is materially reduced, the cells show the effect very readily. I presume that in the brain there might be similar changes.

There may be some of you who have had experience in studying brains in which in certain places circulatory impairment was apparent. Dr. Papez, perhaps you could tell us something about this.

DR. PAPEZ: In most of our specimens we have also examined the blood vessels in the cortex and thalamus. The blood vessels in the cortex show many more changes than those in the thalamus, so far as I have been able to determine in our cases. We have many samples of the living cortex, that is very fresh cortex, and the blood vessels invariably show changes. Those changes occur chiefly in the perivascular region. Fatty bodies are imbedded in the surface of the blood vessels, which appear sometimes studded on the outside with inclusion bodies that resemble a series of barnacles. At the bifurcations of blood vessels, they are often intracellular, that is, they are inside the connective tissue cells and undergo the easily recognized morphologic changes. Certain changes in staining are apparent. The head granule, for example, gets large. Frequently they show signs of degeneration.

So the condition in the walls of blood vessels, I think, is related to the condition in the nerve cells. There is apparently a reciprocal relation. Mrs. Papez and I have studied these changes under the oil immersion lens for a period of eight years. We at one time thought that something was carried between the blood vessel and the nerve cell; but now, we do not think that is necessary, because the living organisms as we see them under the dark phase microscope are so extremely active and can fasten themselves to tissue, move with tremendous agility, and exhibit so much activity for ten or fifteen days or more after the specimen has been secured, that there is no reason for considering a carrier such as the microglia cell.

I have had a feeling for a long time that the patches formed on the blood vessel are the result of this type of parasitic pathology. How they get down on the large cerebral vessels we have not been able to determine; not for the lack of material, but for the lack of time. They must get down on the outside of the blood vessels, because these patches

occur all the way from the cortex down to the basilar and carotid arteries. Although this investigation has not yet been carried out, we think a reciprocal relationship between the disease of the nerve cell and the neighboring blood vessels is a very important consideration.

CHAIRMAN KUNTZ: Has anyone anything further to contribute that has a bearing on this particular problem?

In the papers presented today, particularly the last one, the chromophil substance was much in evidence. Can we point out that the changes in the chromophil substance in the neurons are in any way related to the aging process, or do we have to think of changes in the chromidial substance as related to the functional states of the cells?

Some of you may recall that many years ago Dr. Dolley, in studying the effects of stimulation on nerve cells and working particularly with Purkinje cells in the cerebellum, developed a theory that the chromidial substance is the substance which supplies the energy for the activity of nerve cells and that as nerve cells are stimulated, that is, are kept active, simultaneously the chromidial substance is consumed. But there is the reaction on the part of the cells to restore the chromidial substance, so new chromidial substance is formed in the cytoplasm. That process, according to Dolley, is controlled by something that moves out from the nucleus; that is, there is a drain on the chromatin material in the nucleus.

If nerve cells are stimulated and kept active, the chromidial substance is consumed, but the first reaction on the part of the cell is to restore or build up new chromidial substance in the cytoplasm. That will go on for as long as the cell is able to meet the situation. But finally the chromidial substance will practically all be consumed and there will not be much left that is stainable either in the cytoplasm or in the nucleus.

We have tried to do something of the same sort with autonomic ganglion cells. It is apparent that as a ganglion is stimulated—and you can do that by electrical stimulation of the preganglionic fibers—in a very short time many of the ganglion cells will show a reduction in the amount of chromidial substance. Some of them will show evidence of building up new chromidial substance in the cytoplasma, usually near the nucleus. As stimulation continues, some of the cells become depleted.

One can also reverse these conditions. If you make some estimate of the number of cells that are rich in chromidial substance in the resting animal and then estimate again after stimulation for some time, you will find that after continued stimulation for a good while there will be a much larger percentage of the cells that seem to be depleted; that is, they are poor in chromidial substance.

Inasmuch as you can produce changes like that in the quantity and also in the distribution of chromidial substance in the cells, the question arises, is it worth while to consider the chromidial substance when one studies aging, that is, does it have any bearing on the problem of aging or are the changes in the chromidial substance merely nutritive changes? Should we rule out the chromidial substance when we are trying to find changes that are related to aging?

Dr. O'Leary, have you any comments?

DR. O'LEARY: I don't believe I have on that. I rather find myself in agreement with the problem as you pose it.

CHAIRMAN KUNTZ: Are there any other cytochemical constituents of nerve cells that should be considered? Who knows anything about the function of the Golgi apparatus?

DR. J. M. SOSA: This is a real problem, sir. For so many years so many people have been working on the Golgi apparatus. This element has been studied in so many ways, and has even been disgracefully treated by some people who consider that its real purpose does not exist. It is very difficult actually to consider the problem of the general biologic meaning of the Golgi apparatus in the nerve cell.

Regarding my personal point of view, I consider the Golgi apparatus from two different points of view. Fundamentally I believe it has a physical significance common to every kind of cell, and this is a condition dealing with metabolic activity. But that is the only thing we can say. Which kind of metabolism the Golgi apparatus has to do with, we do not know.

It seems to me that the Golgi apparatus reacts in a very different way according to the specific activity of the cell we are considering. That means that the functional significance of the Golgi apparatus in a nerve cell cannot be the same in the case of a glandular secretory cell and in the case of a muscular one. And so it seems to me that it is connected with the specific condition of the particular cell, but which part this element takes in the activity of a specific cell is something we certainly do not know.

We have studied the Golgi apparatus in many different types of cells. We have seen how it changes with different physiologic and pathologic conditions. It changes according to the different stages of living, but so far it looks as though we can deal only with morphologic variation rather than with real chemical and functional significance.

I have entered into the study of the Golgi apparatus by using the electron microscope. I have tried to study the physical chemical condition. This study has led me to support the idea that the Golgi apparatus is in an extremely divided condition from the molecular point of view. That agrees with the facts described by Beams in this country regarding the vari-

ations of the Golgi apparatus with ultracentrifuging.

On the other hand, from the chemical point of view, the observations so far are more negative than positive. For instance, I have been able to demonstrate, I believe, that there is no vitamin C inside the Golgi apparatus. When it has been claimed that vitamin C has been shown, it has not been vitamin C but silver nitrate reduced by the action of the sodium hyposulphate, producing finally the silver sulphide, which has nothing to do with vitamins.

The connection with protein and lipid elements is something that is really not solved. Many of the facts in favor of the existence of lipid parts inside the Golgi apparatus seem to me to have nothing to do with the real Golgi apparatus. I mean the fats or fatty substances that have been described by some authors as connected with the Golgi apparatus are not part of this apparatus, but what are called metagolgisomes, that is, elements that are perhaps produced or elaborated by the Golgi apparatus but do not form any important part of it.

And regarding the part taken by proteins in the chemical constitution of the Golgi apparatus, certainly I have tried many different chemical reagents as used by chemists in the test tube, but all have given negative results. So I think that rather than give up we must continue to try to find better methods for studying the chemical and physical chemical condition of the Golgi apparatus. That is why I have continued to work on this structure for over twenty-five years.

CHAIRMAN KUNTZ: Are there any other problems that onyone would like to raise? One might be, what cytologic variations indicate aging, and what cytologic criteria can we use?

DR. SOSA: For me the most constant element indicating aging in nerve cells is the lipofuscin, the lipochrome pigment. It rarely appears in younger subjects, but does appear beyond a certain age. I have not seen it in very young persons. As a matter of fact, while we can get lipofuscin in some pathologic conditions, the truth is that we can get a great deal of this material in elderly persons. To me it is very clear that this element increases with age. I believe that this is the most important element shown in the cell and that other elements, such as variation in the neurofibils, Golgi apparatus and, in some cases, the Nissl bodies will have a secondary place

CHAIRMAN KUNTZ: Is there anything further that anyone would like to have considered before we close? If not, we will declare this session adjourned.

(The meeting adjourned at four-thirty o'clock.)

Senescence of the Cardiovascular System

Problem Identification

Second International Gerontological Congress and Fourth Annual Scientific Meeting of the Gerontological Society, Inc.

Tuesday Afternoon, September 11, 1951

Participants: P. D. White *Chairman*, Boston, Massachusetts

A. J. Carlson, Chicago, Illinois

K. J. Franklin, London, England

J. Groen, Amsterdam, Holland

O. Olbrich, Sunderland, England

H. S. Simms, New York, New York

C. J. Van Slyke, Bethesda, Maryland

EDITED BY P. D. WHITE

CHAIRMAN WHITE: I would like to make four suggestions myself as to the importance of future studies in relation to diseases of the cardiovascular system in old age and concerning gerontology itself.

The first is that serious effects of "aging," as has been shown today, particularly in Dr. Gertler's paper, may begin in youth. What is the age limit for the so-called diseases of old age? Is there any age at which they begin? Isn't it rather artificial or indeed a mistake to establish such a specialty as geriatrics when it might have to begin at the age of 30 if one is going to treat coronary thrombosis as a geriatric disease? Gerontology, of course, is the science of aging, and in that respect it has its place.

The second point I want to make is the predominant importance of social problems versus medical problems in gerontology. I should like to quote William Menninger, who delivered the Arthur Little Memorial Lecture at the Massachusetts Institute of Technology this year, entitled "Social Change and Scientific Progress." He said, "Surveys have shown repeatedly that from 60 to 70 per cent of discharges from jobs occur because of social incompetence rather than technical incompetence." I would add "or medical disability." No matter how that term "social incompetence" may be interpreted, it is a challenge, I think, to us physicians. We are, after all, our brothers' keepers, not only medically but socially.

The third point I would like to make is that of the great importance of heredity. That has been shown today, I think, quite clearly with respect not only to longevity but also to atherosclerosis, coronary artery disease, body build, metabolism, blood pressure, the tendency to rheumatic fever, neurocirculatory asthenia, and cancer. I mean that heredity is a very vital factor in disease.

Finally, the fourth fact I would like to stress is, as has been pointed out today, the great importance of sex. We know about one woman, very muscular, about the age of 37, I think, who had a coronary thrombosis right after she had carried a ton of coal up from her cellar. She did not carry it in one load but she actually transported a ton of coal. She was a coal heaver in build. So it is not all a matter of sex (and an associated defect in fat metabolism and utilization). There are other things that enter in, such as the muscles and their use. However, sex has been the most important factor in my own young coronary cases.

Those are some suggestions which I would present in connection with future heart problems, and I emphasize particularly the need that we, as physicians, cooperate with and stimulate the social scientists, who are too few in number, in pioneer efforts in gerontologic research in the future.

I should like to call on Dr. Franklin to add a word.

DR. K. J. FRANKLIN: There are just two things that I should like to mention. The first is that I think we could get a much more functional idea of the circulatory changes due to aging in the cardiovascular system if we were to use the possibil-

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ities of radiography allied to the intravenous injection of radiopaque materials.

Professor Yager has now developed an exceedingly good radiographic method for taking full-sized pictures of the chest and other parts of the body. It seems to me that in that way either comparative pictures could be obtained of the circulation in the chest and elsewhere in different age groups, or else, for reference as a long-range proposition, pictures could be taken of a particular group during succeeding decades of their own lives; in that way one would get a very striking picture of the circulation with its changes in aging.

The other thing that struck me today particularly is that we have had reference to the heart and to the arterial side of the circulation in aging; but there has not been a word, so far as I have heard, on aging in relation to the venous system, which surely is as important as the arterial.

CHAIRMAN WHITE: Thank you, Dr. Franklin. Dr. Van Slyke, may we hear from you?

DR. C. J. VAN SLYKE: I find that what I have to say does not refer to a specific problem for research in the field of aging, but I have certain general comments to offer.

I have been pleased, frankly I have been thrilled, by the international flavor of this International Congress, and I think the one thing that we can all take home with us is the fact that if we are to advance in solving the many problems which face us, we must do so on an international plane. Dr. White and others have heard me talk, possibly even complain a little bit, about the lack of international flavor to some of our research studies. I would not for a moment have you think that Dr. White has not been most encouraging in getting me to complain, because that would be far from the truth.

But we hear today about the fraüleins of Holland, who apparently have a different biologic approach to coronary disease than others. I recall that when I was a young fellow there was a very popular song called "Katerina," and it referred to the buxom lass, so buxom that it apparently took two men to love her. So there probably was a legend back in those days that there was a biologic difference in, shall we say, the nonthin girl.

I refer, not facetiously, to such geographic differences as climate, which we have not more than mentioned today; to differences in foodstuffs that are found around the world. Yes, I know they contain so much protein, carbohydrates, and fats. But what about the trace elements that are found in these foods which are indigenous to certain areas? What effects do they have on the production of pathology or the maintenance of good health?

Further in the matter of international cooperation in the field of research in gerontology, it is my great privilege to acknowledge the very fine cooperative endeavor which the American Heart Association, our British colleagues, and the National Heart Institute are now making in the field of testing the use of ACTH and cortisone in rheumatic fever and its possible use as a preventive against the development of rheumatic heart disease.

There are two or three more points, Dr. White, that I should like to mention. I believe that the stress on the fact that statistics, data, and findings might well be broken down by decades is a very important one. In that connection I have a word which I think probably won't be too pleasing to some in this Conference, but I think that there is a danger in getting into the field of gerontology per se, carving out a segment of the biologic and medical field and calling it gerontology.

I am sure that the interest we have in the problem of senescence and the problem of aging is an interest which should be science-wide, and by "science" I mean exactly that: economics, humanities, sociology, as well as the medical and biologic approach to it. I think that many of our colleagues, particularly in the medical and biologic fields, have tended, not consciously possibly, but definitely have tended to avoid studies looking into the aging problem as such. They have tended to limit their observations up to a certain age with the idea that the "crocks" (who, according to the definition I have heard, are those old people from whom the diagnostic sheen has been worn off) are not of particular interest.

I think that we can stimulate an interest throughout the whole span of life. If we do that, we shall not only find it unnecessary to break this subject down into a specialized segment called gerontology, but we shall be able to stimulate a great deal of worthwhile work in this field.

Longitudinal studies can be carried out, not only in the chronic disease hospitals but in such places as old-soldier homes, for instance, wherein economic conditions have dictated the presence of the inmates, not necessarily their medical conditions. And I believe that some of the plans which the Gerontological Society has for getting into this sort of thing have a lot of merit; if any of us has a chance, I think that he should encourage them.

I heard in the discussions yesterday and today statements which gave rise to differences of opinion. I think the admonition which I now give is one which you all hold, but I just mention it to refresh your memory. At times there seems to be a slavish acceptance of the infallibility of some of the methods we use.

Let's put it down in terms that we can understand. Are prothrombin time methods accurate? Are methods for determining cholesterol as accurate as we would like to have them? Has Gofman's work on the

lipoprotein and the S_{F10-20} molecules progressed to the point where we can use his data or anybody else's data as having validity? Frankly, in connection with this last point, I don't think so. And having been involved in the last three or four weeks in a series of cholesterol determinations among good laboratories, I have lost a great deal of faith in the value of some of the methods. However, I don't think that that should do anything but stimulate us to correct our deficiencies.

The last thing I have to say is something I almost envy myself the privilege of saying. I have had the good fortune to be associated with one of your co-chairmen for a number of years, and I cannot think of a finer way to conclude my few remarks than by expressing appreciation to him for what he has done in this field. A wonderful gentleman to work with, hard-working, objective, and a true friend—Dr. White!! (Applause)

CHAIRMAN WHITE: Thank you, Dr. Van Slyke, for all your remarks.

Dr. Carlson, would you say a few words? (Applause)

DR. A. J. CARLSON: Mr. Chairman and Fellow Citizens: I do not have anything particularly new or important to say. I don't assume that it is our function here to point out all the important lines of research necessary in gerontology; but so far as the topic of this afternoon is concerned, it should be plain to us all that we do not yet know all the facts determining hypertension, hardening of the arteries, and coronary heart disease. And I am quite sure, despite the remarks of one of the speakers this afternoon, that we cannot get experimental animals to learn on and then apply the data to human beings, but that we have got to follow both man and the experimental animal, thoroughly, until we get enough information so that we can at last begin to prevent these conditions.

It is perfectly clear, so far as this special topic is concerned, that we have got to call in both laboratories and clinics more and more in every country. I should like to see work extended in northern China, where I understand that hypertension is less common than in some European and American countries.

Another topic which is of some importance, undoubtedly, is diet, and diet may be a factor even in cardiovascular diseases. You see, there is no line of separation.

Yes, that brings up another question. If we continue to breed like rabbits, as we have largely done in the past, won't we have to live and die like rabbits because of lack of food? So the matter of population and food supply also becomes a problem, not as immediate, not as direct, to be sure, but certainly for the future.

Now, I want to say a word, not as a scientist or a physiologist but as a guinea pig. I had a coronary heart attack the second week of January of this year. An able internist sat on me in the hospital for five weeks. I discovered personally what I had suspected would be the case under a given condition: that to do nothing is the hardest work for me. And I wonder if you will accept me as a guinea pig. In other words, one healthy factor in aging, it seems to me, is continuous physical and mental labor. And wouldn't we have to consider that at every stage of human life, so that when one reaches 67, 80, or 90, one can still be stimulated by the fundamental curiosity of man, which, under the present conditions, by that age is usually killed?

CHAIRMAN WHITE: Thank you, Dr. Carlson.

Dr. Simms!

DR. H. S. SIMMS: I think we will all agree that much more research is needed on the etiology of arteriosclerosis. Work on this problem, or group of problems, is slow, but at the present time we are much further along than we were ten years ago. That will be obvious tomorrow at the meeting of the arteriosclerosis section and also at the meetings at Chicago in November, of the Arteriosclerosis Society.

There are a number of laboratories working on various substances present in blood plasma which apparently play a role in causing and preventing the deposition of fat in atherosclerosis. It is important that this work go on and be correlated, so that we may get a better picture of the mechanism involved in this process. I am hopeful that it will be only a few years before we may have a good conception of the means by which the fat is deposited.

Then we also need research on the influence of age in predisposing the artery wall to the deposition of fat and on the changes taking place with age and predisposing to the deposition of fat.

These problems may sound simple, but I think that in a few years we shall have a conception of the whole process which will actually be simple. (Applause)

CHAIRMAN WHITE: Thank you, Dr. Simms. Dr. Olbrich, will you please continue the discussion.

Dr. O. OLBRICH: Mr. Chairman, the chief problem for me is this whole conception of problem identification. What I shall try to define is not the pursuit of the researches themselves but something from which we suffer, and that is that the yardstick by which we measure is really not international. When we do any work or experiments, although the language we speak is the same, our measurements, our tests, our stress symbols, our methodology, and our clinical investigations differ vastly from each other. Here is an opportunity to streamline these difficulties and at least in some

selected experimental units all over the world have our work coordinated by an international body.

A second very important point is the fact that there is a very great discrepancy between the clinic and laboratory experiments. The problem identified clinically is quite clear and can be followed up. When we try to repeat it in animal experiments, which are carried out under totally different conditions and on totally different bases, we, of course, get a different answer. That is the second point.

The third point, and this is more of a complaint than a suggestion, is that very few controls are carried out in these experiments or clinical investigations. I am especially very suspicious of things that are so-called statistical studies.

Therefore I would like to see one day an international body called and brought together—I do not care what you call it—and have all the investigators sit down and determine how we shall measure cholesterol, for instance. Dr. Pollak pointed out to you quite clearly that I have my personal impression and he has his own. There is a discrepancy, and so we get into confusion.

Although we use the same tongue, we speak in an entirely different language due to lack of coordination. It is not due to lack of problem identification, because we identify the problems; but the working out of the problems and the unification of our aims are grossly lacking. That occurs not only internationally, but the same thing happens in the same country among the clinicians, the anatomists, and the physiologists—there is no coordination although they are all facing the same problem.

So if I may put forward that suggestion, we might some day be better able to discuss these most important problems.

Thank you very much. (Applause)

CHAIRMAN WHITE: Thank you, Dr. Olbrich. I am sure we would welcome any further suggestions from the floor if anybody has anything he would particularly like to say as to future activities or thought. Dr. Groen, will you please conclude the discussion.

DR. J. GROEN: I am speaking as a clinician. I think we all agree that by the time a patient reaches the clinician or comes to autopsy, we see end results: end results of atherosclerosis, hypertension, or age changes in the arteries. It follows that what we need is, above all, a good study of so-called normal individuals, a long-range study, in which we are able to follow them up for many years until the time when they become ill or when they come to autopsy.

Such a program of study, so far as I know, is carried out only in Minneapolis at present, by Dr. Keys and his associates. It would be extremely valuable to have that sort of study carried out in many places on the earth, because there we could use ways of distinguishing between groups of people who have followed various modes of nutrition, who have been exposed to various forms of external stress, among which have been various forms of psychologic and social difficulties. This would be a long-range program, and it is very likely that the results would only be known if one of the investigators who took part in it were still alive. But it might be worth while for us, and it might give definite answers to those who come after us. (Applause)

CHAIRMAN WHITE: Thank you for that very important suggestion. I can add an encouraging word about it. There is just such a study under way in Framingham, Massachusetts, under the auspices of the United States Public Health Service.

I remember visiting Sir James Mackenzie when he had this idea of a study in which all the population was to be enrolled; and any time there was any disease, it was to be recorded, and frequent medical examinations were to be recorded. It was carried on until Sir James Mackenzie died, and then the study died with him. There were only two annual reports.

We hope that the Framingham plan will go on more or less to perpetuity. That is the main object of this study in Framingham.

The time is up. I want to thank the audience for its attention, and I particularly want to thank my colleagues for all their help.

Thank you very much.

(The meeting adjourned at five o'clock.)

Nutritutional Aspects of Aging

Problem Identification

Second International Gerontological Congress and Fourth Annual Scientific Meeting of the Gerontological Society, Inc.

Wednesday Afternoon, September 12, 1951

Participants: C. M. McCay, *Chairman*, Ithaca, New York

P. Alessandrini, Rome, Italy
S. Brody, Columbia, Missouri
M. Brush, St. Louis, Missouri
T. Geill, Copenhagen, Denmark
M. K. Horwitt, Elgin, Illinois
K. Knowlton, Bethesda, Maryland
V. Korenchevsky, Oxford, England
M. A. Rudzinska, New York, New York
J. A. Saxton, Jr., St. Louis, Missouri
R. R. Spencer, Bethesda, Maryland

EDITED BY C. M. McCAY

CHAIRMAN McCAY: Dr. Alessandrini, you have been very quiet this afternoon. I wonder whether we could not start with you.

DR. P. ALESSANDRINI: I do not speak English well.

CHAIRMAN McCAY: You could tell us, though, briefly, what you think is the most important problem that you have heard discussed in regard to nutrition and old age.

DR. ALESSANDRINI: The most important question is autointoxication.

CHAIRMAN McCAY: Dr. Horwitt!

DR. M. K. HORWITT: It seems to me that I have heard three separate points of view during the course of the day. The first was presented by those men who have the problem of curing the disabilities of old age, and they talk in terms of nutrition as being a good thing to have. We should have more nutrition; therefore, if one needs a half gram of a certain substance, give the old man twice as much. That would leave the old man in a position where nutritionally, he requires more of something than the young man.

Then you have another type of thinking in which the small-cell animal experimentalist gets the impression that, since the cell gets along better with a minimum of nutrition, it is therefore perhaps wiser to give the old man less than the young man, and he might live longer. Now, I am talking on a long-term basis of old age. If we follow that idea through, there are some benefits derived from eating less than is normally required.

In between, you might have the group which is trying to do controlled work in this field and trying to report that they cannot find any differences between the requirements of the old and young, if they control their experiments and run them long enough.

Somewhere along here we have to have a meeting of the minds. They cannot all be right. The suggestion is made (and you find it frequently in the literature) that the old man does not absorb his food as well as the young man and, because he does not absorb his food as well, therefore you have to give him more. But I am not aware of a single paper that has shown that the old man cannot absorb a water-soluble material. I will leave fats out of this for the time being. And I have not seen a single paper which has proved that when the old man and the young man are put on the same diet, in the same room, in the same environment, that the old man needs more protein, thiamin, riboflavin, ascorbic acid, or anything else, provided one controls one's experiments. As you know, we ran such experiments for three years and could not prove any differences.

And therefore we have to so arrange our problems that we eliminate the controversy between these three different types of thinking. As I see it, we either have to recognize the work that has been done which has attempted to show that the differences do not exist between the healthy old man and the healthy

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young man, or else we have to do that work over again and give it sufficient publicity, so that we somehow should get the idea across that the old man's absorption is as good as the young man's, provided he is well, and that, since he is not any more active than a young man, his requirements are not greater.

CHAIRMAN McCAY: Could you state that in a couple of sentences for us, as you would project it into a general research title?

DR. HORWITT: I think work should be done simultaneously, first, on the absorption of the nutrients as we know them (the vitamins, amino acids, proteins) in young and old, to show whether there is any scientific basis for the conception that the old man does not absorb his food as well as the young man.

CHAIRMAN McCAY: Dr. Knowlton, you are next in the circle.

DR. K. KNOWLTON: I agree with the formulation of the problem as given by Dr. Horwitt. I should like to see considerably more extensive study of that sort undertaken, analogous to that done by Dr. Macy, with children. I should like to see the correlation made at the same time, in the same place, under the same seasonal conditions and general controls, and if possible, I should like to see it done with members of different generations of the same family. I think that it is a more important consideration in obtaining adequate control material than we have yet realized.

CHAIRMAN McCAY: Dr. Geill, you are next in our thinking here.

DR. T. GEILL: I found today that it was very interesting to hear Dr. Kountz' work concerning the nitrogen balance, because it seems that old people need more nitrogen and more protein than young people. It is not very unusual to find old people who are eating very little, and I think that it is necessary to give old people who are in a very bad condition more proteins and more nitrogen.

I am very interested in the vitamins, too. I should like to know if you could tell me if the old people need more of the different vitamins, especially those under the vitamin B group, than do young people. I think, Dr. McCay, that you know something about vitamins in rats, old rats.

CHAIRMAN McCAY: Dr. Horwitt knows about people.

DR. GEILL: Do they need more vitamins than young rats?

CHAIRMAN McCAY: I do not know. You have found little difference between your old and your young?

DR. HORWITT: No.

DR. GEILL: During the war, we saw several cases of avitaminosis among our old patients, especially among our women, because the population of Denmark got very little meat and very little milk. These cases of avitaminosis disappeared after the people were able to get milk and meat as usual.

DR. M. A. RUDZINSKA: I know I am alone here, the only one who works on one-celled animals, on protozoa, but since I have this experience for making a comparison with the result on animals, I think it would be of great importance to consider similar research on one-celled animals. With such one-celled animals, we do have a life span extending four days. I must advertise my animal which is an exception among protozoa, because, as you know, a protozoon lives simply for hours. It divides and forms two new organisms. It is the new organism I work on, and that has a life span of four days. Therefore, there is a possibility of conducting research in young and old.

I have definite results about overfeeding. I could not tell at this stage, for instance, the difference between young and old on medium diet, or on overfeeding. The time I have spent working on this problem has been too short, but I think there is a possibility of doing such work for a longer time.

Then, here has been raised the problem that it will be of interest to conduct research through generations, and this might be a perfect subject for such a problem, because reproduction goes on so quickly. It would be of great interest to study, for instance, individuals which come from poorly fed parents and those who come from heavily fed parents to find out the life span of those individuals and all the different kinds of variations and also deficiencies in those organisms.

As I explained, they feed on other protozoa fed on a synthetic medium. It is very easy to keep them in a medium with some deficiency and then study the influence of such organisms on this particular protozoon. As I mentioned in my talks, I have some results along those lines: there is a definite influence from the quality of food.

CHAIRMAN McCAY: That is fine.

Dr. Brody, I am not going to let you escape before you give us your comments.

DR. S. BRODY: What is your problem?

CHAIRMAN McCAY: One of the most outstanding problems in the interrelations between aging and nutrition that can be attacked.

DR. BRODY: It seems to me that man should be eliminated from the category of experimental animals, because of his unknown heredity.

CHAIRMAN McCAY: We want positive statements here, young man, not negative ones.

DR. BRODY: You made a statement in regard to dogs. I feel the same way about man.

I think that Carrel's approach is scientifically the best one in the study of tissue culture in vitro. He

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R. R. Spencer, Bethesda, Maryland

EDITED BY C. M. McCAY

CHAIRMAN McCAY: Dr. Alessandrini, you have been very quiet this afternoon. I wonder whether we could not start with you.

DR. P. ALESSANDRINI: I do not speak English well.

CHAIRMAN McCAY: You could tell us, though, briefly, what you think is the most important problem that you have heard discussed in regard to nutrition and old age.

DR. ALESSANDRINI: The most important question is autointoxication.

CHAIRMAN McCAY: Dr. Horwitt!

DR. M. K. HORWITT: It seems to me that I have heard three separate points of view during the course of the day. The first was presented by those men who have the problem of curing the disabilities of old age, and they talk in terms of nutrition as being a good thing to have. We should have more nutrition; therefore, if one needs a half gram of a certain substance, give the old man twice as much. That would leave the old man in a position where nutritionally, he requires more of something than the young man.

Then you have another type of thinking in which the small-cell animal experimentalist gets the impression that, since the cell gets along better with a minimum of nutrition, it is therefore perhaps wiser to give the old man less than the young man, and he might live longer. Now, I am talking on a long-term basis of old age. If we follow that idea through, there are some benefits derived from eating less than is normally required.

In between, you might have the group which is trying to do controlled work in this field and trying to report that they cannot find any differences between the requirements of the old and young, if they control their experiments and run them long enough.

Somewhere along here we have to have a meeting of the minds. They cannot all be right. The suggestion is made (and you find it frequently in the literature) that the old man does not absorb his food as well as the young man and, because he does not absorb his food as well, therefore you have to give him more. But I am not aware of a single paper that has shown that the old man cannot absorb a water-soluble material. I will leave fats out of this for the time being. And I have not seen a single paper which has proved that when the old man and the young man are put on the same diet, in the same room, in the same environment, that the old man needs more protein, thiamin, riboflavin, ascorbic acid, or anything else, provided one controls one's experiments. As you know, we ran such experiments for three years and could not prove any differences.

And therefore we have to so arrange our problems that we eliminate the controversy between these three different types of thinking. As I see it, we either have to recognize the work that has been done which has attempted to show that the differences do not exist between the healthy old man and the healthy

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young man, or else we have to do that work over again and give it sufficient publicity, so that we somehow should get the idea across that the old man's absorption is as good as the young man's, provided he is well, and that, since he is not any more active than a young man, his requirements are not greater.

CHAIRMAN McCAY: Could you state that in a couple of sentences for us, as you would project it into a general research title?

DR. HORWITT: I think work should be done simultaneously, first, on the absorption of the nutrients as we know them (the vitamins, amino acids, proteins) in young and old, to show whether there is any scientific basis for the conception that the old man does not absorb his food as well as the young man.

CHAIRMAN McCAY: Dr. Knowlton, you are next in the circle.

DR. K. KNOWLTON: I agree with the formulation of the problem as given by Dr. Horwitt. I should like to see considerably more extensive study of that sort undertaken, analogous to that done by Dr. Macy, with children. I should like to see the correlation made at the same time, in the same place, under the same seasonal conditions and general controls, and if possible, I should like to see it done with members of different generations of the same family. I think that it is a more important consideration in obtaining adequate control material than we have yet realized.

CHAIRMAN McCAY: Dr. Geill, you are next in our thinking here.

DR. T. GEILL: I found today that it was very interesting to hear Dr. Kountz' work concerning the nitrogen balance, because it seems that old people need more nitrogen and more protein than young people. It is not very unusual to find old people who are eating very little, and I think that it is necessary to give old people who are in a very bad condition more proteins and more nitrogen.

I am very interested in the vitamins, too. I should like to know if you could tell me if the old people need more of the different vitamins, especially those under the vitamin B group, than do young people. I think, Dr. McCay, that you know something about vitamins in rats, old rats.

CHAIRMAN McCAY: Dr. Horwitt knows about people.

DR. GEILL: Do they need more vitamins than young rats?

CHAIRMAN McCAY: I do not know. You have found little difference between your old and your young?

DR. HORWITT: No.

DR. GEILL: During the war, we saw several cases of avitaminosis among our old patients, especially among our women, because the population of Denmark got very little meat and very little milk. These cases of avitaminosis disappeared after the people were able to get milk and meat as usual.

DR. M. A. RUDZINSKA: I know I am alone here, the only one who works on one-celled animals, on protozoa, but since I have this experience for making a comparison with the result on animals, I think it would be of great importance to consider similar research on one-celled animals. With such one-celled animals, we do have a life span extending four days. I must advertise my animal which is an exception among protozoa, because, as you know, a protozoon lives simply for hours. It divides and forms two new organisms. It is the new organism I work on, and that has a life span of four days. Therefore, there is a possibility of conducting research in young and old.

I have definite results about overfeeding. I could not tell at this stage, for instance, the difference between young and old on medium diet, or on overfeeding. The time I have spent working on this problem has been too short, but I think there is a possibility of doing such work for a longer time.

Then, here has been raised the problem that it will be of interest to conduct research through generations, and this might be a perfect subject for such a problem, because reproduction goes on so quickly. It would be of great interest to study, for instance, individuals which come from poorly fed parents and those who come from heavily fed parents to find out the life span of those individuals and all the different kinds of variations and also deficiencies in those organisms.

As I explained, they feed on other protozoa fed on a synthetic medium. It is very easy to keep them in a medium with some deficiency and then study the influence of such organisms on this particular protozoon. As I mentioned in my talks, I have some results along those lines: there is a definite influence from the quality of food.

CHAIRMAN McCAY: That is fine.

Dr. Brody, I am not going to let you escape before you give us your comments.

DR. S. BRODY: What is your problem?

CHAIRMAN McCAY: One of the most outstanding problems in the interrelations between aging and nutrition that can be attacked.

DR. BRODY: It seems to me that man should be eliminated from the category of experimental animals, because of his unknown heredity.

CHAIRMAN McCAY: We want positive statements here, young man, not negative ones.

DR. BRODY: You made a statement in regard to dogs. I feel the same way about man.

I think that Carrel's approach is scientifically the best one in the study of tissue culture in vitro. He

did not go very far with it. He found that the serum from old animals supports life to a lesser extent than that from young animals, but that it is not very far. I think we should——

CHAIRMAN McCAY: Extend the Carrel studies?

DR. BRODY: —extend the Carrel studies.

CHAIRMAN McCAY: I am sure all the people are interested in lower forms.

DR. BRODY: It seems to me that should be the basis for study.

CHAIRMAN McCAY: Dr. Saxton, may we hear from you?

DR. J. A. SAXTON, JR.: I came in later in the afternoon session.

CHAIRMAN McCAY: You are a pathologist and have been thinking of nutrition for a long while.

DR. SAXTON: The main point I should like to stress would be that in any study of a population group of, let us say, advanced age in a chronic institution, or something of that sort, one should take into account the fact that, as people grow older, they become more diverse physically, mentally, and probably several other ways; that one cannot group them as one can a group of young experimental animals.

One should take particular pains to evaluate their physical status, I think, in trying to interpret the results of any nutritional studies on them, or the effects of various types of nutrition. That would more or less include, I suppose, any of the projected studies that have already been discussed. I agree with the idea that one should have some evaluation of their physical status so far as chronic disease is concerned, and certainly at the termination of their life one should have an autopsy to confirm and correlate the results.

DR. R. R. SPENCER: This is not my field.

CHAIRMAN McCAY: That is all right. You have have been thinking about these things in relation to cancer for a long wh , haven't you?

DR. SPENCER: Yes. May I ask this question? Do you think that in spite of the fact that we do not have sufficient information that you could perhaps generalize to the extent that, as one grows older, barring occupation's demanding extreme labor, one should gradually decrease his aliment, as I believe, Cheyne advocated. Should we, in the light of our present knowledge, concentrate on taking concentrated foods (vitamins and hormones)? Would any of you suggest that to older people?

CHAIRMAN McCAY: Cheyne had a lot to decrease. Wasn't he the fattest physician in London in his day? He weighed 400 pounds, so he had quite a lot to decrease as he got older.

DR. M. BRUSH: I should like to suggest that perhaps some of the confusion which Dr. Horwitt has pointed out could be cleared up if we were a little more specific. That is, there are certain people who say we should have more of something; well, the "more of something" that many of them recommend is more protein. But there are others who say we should have less of something; the "less of something" that they recommend is less of calories. So there is not necessarily a contradiction between those two.

And another point that is sometimes confusing is that some people have said that old people should have more protein. Very often they mean not more protein than younger people but rather more protein than our idea of what the old people needed to have in the days of tea and toast.

CHAIRMAN McCAY: You are defining our need in research as a need for determination of protein requirements?

DR. BRUSH: No, that is not so much a comment on a problem to be projected, but on our current ideas with regard to older people.

One thing I should be interested in seeing expanded is work on the calorie effect.

CHAIRMAN McCAY: So would Dr. Horwitt.

DR. BRUSH: I should like to see us get a mechanism for increasing the life span and decreasing cancer incidence because of calories.

DR. SPENCER: I should like somebody to answer my question, if it is possible: whether or not, as you grow older, you should decrease your intake of protein and energy foods and depend on these concentrated vitamins and amino acids that are so much in vogue.

CHAIRMAN McCAY: Would anybody like to tackle that?

DR. KNOWLTON: I am only going to tackle it to the extent of saying that I think that is exactly the purpose of most of the suggestions which have now been made. We cannot, as yet, say that, but we all believe that we must find that out. And these various, rather closely related suggestions which have so far been made, are all pointed to that end. But I would say we cannot yet answer. Is there disagreement?

CHAIRMAN McCAY: I think everyone would agree with that.

I am saving Dr. Korenchevsky for last, because I am sure he knows more about this than all of us together.

Dr. Korenchevsky, I have saved you until last because I know you have thought more about this than any of the rest of us.

DR. V. KORENCHEVSKY: I have not, as a matter of fact.

It appears to me that there is, at present, one fundamental question which has to be solved. After the excellent experiments of Dr. McCay, the effects of reduced diet on longevity and on the incidence of

tumors and several degenerative diseases of old age are really of outstanding importance.

Now, again, Dr. McCay, even at this meeting, there are some people (and so there are in every country) who are saying that it is not so, and that, on the contrary, with an especially good diet (take, for instance, Sherman's experiments at Columbia University) better results are obtained.

It appears to me that you, Dr. Knowlton, have shown to us our deficiency in investigating this problem. We know that we have to solve the problem of whether reduced diet or abundant diet is useful, but we have never studied the causes which might be responsible for better conditions of the animals or human beings on reduced diet and on abundant diet. And now you are suggesting one way. You suggest that we study in detail the process of absorption. Then, there are the vitamins. As to vitamins, I have also tried my hand with them, I must confess, and I burned my fingers.

Then there is this problem of autointoxication.

All this, from the point of view of etiology and good effects produced by deficient or abundant diet, so far has not been investigated. I wonder whether Dr. McCay, before we conclude our discussion, could explain to us why his reduced diet prolongs life and why he gets these effects on his animals.

CHAIRMAN McCAY: I have no idea, Dr. Korenchevsky.

DR. KORENCHEVSKY: From my point of view, I think we must solve that problem.

Take this country. I am from England, where we have been on a very austere diet now for many years. For me, it is absolutely impossible to eat as much as you Americans are eating. For instance, here in St. Louis, the other night we had huge steaks. I could eat only about one quarter, and then I was filled. I looked at my American friends who were next to me at the table, and they had eaten the entire steak—males and females.

I think it is a very serious problem, you know—whether this abundant diet is really useful or whether McCay is right. I tend to agree more with McCay than with Professor Sherman of Columbia University. It seems to me that we must admit that good feeding is really necessary for good development and functioning of the organism.

The problem of autointoxication has not been investigated. All the metabolic waste products could be detected comparatively easily in the blood, tissues, and so on. Various factors could be investigated. The study of absorption could be done comparatively easily.

All this must be done in order to answer one fundamental question: how much do we have to eat? Is it much, or very little, or, let us say, medium amount of food? That is the fundamental question. And this question is the most urgent, because, perhaps, for argument's sake, the hypothesis of Metchnikoff and the hypothesis of Carrel are correct. So, in this case, at once, we must proclaim: always and always do not eat much, and all the restaurants in the United States should give, let us say, a quarter of the portion of steak presently served.

DR. SPENCER: I should like to ask a question. Have you noticed, since you have been here, that Americans on a full diet are less alert than Englishmen on a scant diet?

DR. KORENCHEVSKY: May I remind you that Admiral Sherman died from angina pectoris, and I don't think he was 50 years old. So that is what comes of good feeding. It certainly gives you a pickup, but you are paying for it.

DR. BRODY: I just wanted to ask Dr. Korenchevsky about how much to eat.

DR. KORENCHEVSKY: Now, you should modify the question. Are you referring to growing children or are you referring to adults? Dr. Metchnikoff's work was concerned with growing animals. You delayed their growth. But what about adults? It seems to me there is a little confusion between these two. That is very important.

CHAIRMAN McCAY: We have done that study and don't be deluded by that steak. It was the first time in 53 years that I have seen so much steak. And I was deluged with food when I went to Russia for the International Physiologic Congress, but I still do not think the Russians are getting that sort of diet.

DR. KNOWLTON: I should like to make two comments. The first is to re-emphasize the importance I attach to a comprehensive study in which absorption, nitrogen balance, vitamin supply, and several other factors are studied in the same group of individuals, where they can be correlated with many known factors rather than isolated experiments where conditions are different from experimenter to experimenter.

The other thing I should like to emphasize is the point brought out by Dr. Ohlson in the calcium and phosphorus metabolic studies she gave this morning. She indicated there were some individuals who used calcium most economically, who were able to be in balance on a rather small intake, whereas others used it very extravagantly. And I think there may be a great difference in the needs of different strains of individuals. Hence, my earlier request for studies of family, or members of the family. I realize the difficulties.

CHAIRMAN McCAY: That is just as true of dogs. All of our dog work shows the same thing—great variability in calcium assimilation in old age.

(The meeting adjourned at five o'clock.)

What is Aging?

Panel Discussion

Second International Gerontological Congress and Fourth Annual Scientific Meeting of the Gerontological Society, Inc.

Thursday Afternoon, September 13, 1951

Participants: E. V. Cowdry, *Chairman*, St. Louis, Missouri
V. Korenchevsky, *Co-Chairman*, Oxford, England
A. v. Albertini, Zürich, Switzerland
J. Jensen, St. Louis, Missouri
A. I. Lansing, St. Louis, Missouri
R. A. Moore, St. Louis, Missouri
N. W. Shock, Baltimore, Maryland
H. S. Simms, New York, New York

EDITED BY A. I. LANSING

CHAIRMAN COWDRY: Ladies and Gentlemen: This is a kind of experimental discussion. We know that we won't be particularly successful in convincing anybody as to what aging is, but people like to express their views, and this is an opportunity to express views.

I thought that the first step might well be for each member of the panel to have his say; and if that stimulates some discussion, all well and good. If it does not stimulate discussion, I have some questions that I am ready to ask which I am sure nobody can answer properly.

We will first, then, give each member of the panel an opportunity to say what he regards aging to be. I will take them in the order in which their names are printed here.

The first is Professor von Albertini. Professor von Albertini from Switzerland has the floor.

PROF. A. v. ALBERTINI: I shall begin by trying to give you a curve of life (drawing at blackboard). I think we can distinguish here three periods: one of growing up, period A; B, full life after maturity; and the third, C, the period going down.

Often we say that aging begins after birth, but I do not think that is right. I believe it begins at this point (indicating the beginning of period B). What happens in period B, we don't know. That is the period of full activity, the period when mental and physical activities are generally all right if the person is not troubled by any disease. We don't see anything like aging effects, but still we are sure that aging effects begin in this period even though we cannot see them.

But for me as a general pathologist, it is interesting to speak to you about the period when signs of aging are to be seen. The second period, B, is the period of physiologic aging, that is, aging without any pathologic signs. The third period, C, is the period of pathologic aging, that is, aging with pathologic signs.

In general pathology we speak of aging disease as senile atrophy of all states of atrophy of organs. That might be simple atrophy in the brain. In the skin there might be senile atrophy with degeneration of elastic fibers; in hair there might be atrophy indicated by its falling out or becoming white; in the heart senile atrophy is recognized as brown atrophy; in the lung, senile emphysema; in the kidney, senile atrophy; in bone, senile osteoporosis. I think that in every organ we can recognize in this period of real aging an atrophic state.

And what is it? It is a problem of balance between loss and regeneration. I think we can therefore say that loss in this period, C, is greater than regeneration. I call it, therefore, loss of reserves.

In this same period, C, there may be other diseases, such as arteriosclerosis and cancer, which are associated with age but which are only partially connected with the aging process, and which are not identical with the first group of real aging diseases. And there may be other diseases which are associated with aging, and we may say that there exists a predisposition for the diseases. But the diseases I refer to now are not always fully caused by the aging process.

I think that biologically this second group cannot be identified with old age, and I think from the point of view of general pathology only the first group of

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aging diseases should be considered diseases of pathologic aging.

I thank you. (Applause)

CHAIRMAN COWDRY: Thank you very much, Professor Albertini.

The next of our contributors on the program is Dr. A. I. Lansing.

DR. A. I. LANSING: The field of gerontology is sufficiently new that I may pass as a veteran in the area. It is also sufficiently new that there are remarkably few data into which we can sink our teeth for further expansion.

If one attempts to define aging as we use the word today, one gets very rapidly into difficulty for lack of concrete criteria upon which to base such a definition. I recently attempted a definition of aging which I will read.

"At the moment aging can only be defined in very general descriptive terms. It may be defined as a process of unfavorable progressive change, usually correlated with the passage of time, becoming apparent after maturity and terminating invariably in death of the individual."

I really believe that, at this time, we cannot be more specific. Aging is something that correlates with the passage of time. Time is of the utmost importance in aging, regardless of other variables.

We associate aging, as I see it, with maturity. I don't think of aging in the sense that has become popular in recent years, that of aging being the fourth dimension of biology, aging beginning with conception, moving very rapidly through embryonic development and actually slowing down later in life. The fetus is not aging, as I see it; it is not losing vitality; it is not degenerating rapidly. There are of course specialized processes, as in the thymus, which are going downhill. We don't think of the adolescent and his difficulties, physical and mental, as being problems of aging. Those are problems of growth. The problems of aging begin after maturity, when the individual gradually but perceptibly undergoes changes which generally are not favorable, which do not promote further longevity of that individual.

In recent years there has been a sense of urgency in attempting to distinguish between degenerative diseases and aging. This, of course, is a most desirable ambition, but one rapidly gets into difficulties. There are no data that make it possible to strictly define the true aging process as the expression is used. Equally there are no good data to make possible a definition of degenerative disease. We cannot distinguish the mechanisms involved in cardiovascular disease from those of true biologic aging. If we cannot separate them properly and completely, perhaps it is just as well to continue investigations without attempting to decide whether this is degenerative or this is aging, and let the chips fall where they may.

Thank you. (Applause)

CHAIRMAN COWDRY: Thank you, Dr. Lansing.

The alphabetic order I departed from by mistake in calling on Dr. Lansing. I should now like to call on Dr. Julius Jensen.

DR. J. JENSEN: Mr. Chairman and Members of the Congress: Earlier this year I was asking myself repeatedly "What is aging?" One evening I was going to a movie where I found Dr. Cowdry. Figuring Dr. Cowdry would know something about it, I asked him the question, "What do you think is the essential element in aging?"

Dr. Cowdry thought for a minute and then he said, "I believe that it is the gradual loss of the tissue's ability to adapt itself to changing circumstances."

Am I correct in quoting you?

CHAIRMAN COWDRY: Yes.

DR. JENSEN: Well, that sank into my mind, because I thought it was about the best answer I had gotten to my question up to that time, and therefore I do not hesitate in passing it on to you as Dr. Cowdry's opinion.

I can add little to this. However, I do wish to call your attention to the fact that Selye's book starts with the statement that adaptability probably is the most important single fundamental process in life. If instead of the word adaptability, we use the word homeostasis, we may conceive of homeostasis as the effort of the cells to maintain an adequate medium in which to survive. This also seems to be as close as we can come to the sustaining force in life.

What we can say, then, at the present time is that as life passes on, this ability seems to decline. I agree that this term of loss of adaptability is a very general one, but I think it is very important to distinguish between the principle of aging and the effect of aging.

If the loss of adaptability is an essential process of aging, then it seems to me that the histologists should concentrate on this problem. At the present time it is nothing more than a principle, and by that I mean that it is a concept for which we can ascertain the consequences and the effects. But I do believe that our vague knowledge of this principle at the present time arises from the fact that we have not moved in on it yet. I believe very strongly that in the study of gerontology one of the most important and one of the most promising fields is to enter into the study of adaptation and its failure in advancing age.

Thank you. (Applause)

CHAIRMAN COWDRY: Thank you, Dr. Jensen.

The next person on the program is Dr. Nathan Shock.

DR. N. W. SHOCK: Dr. Cowdry, Ladies and

Gentlemen: I might say that my original concept of the discussion this afternoon was not the question as presented, "What is aging?" but "What is gerontology?" On the latter subject I felt prepared to make some statements and defend them, because I believe that that would be a problem of the definition of an area of research. As Dr. Cowdry stated in the beginning, I think an attempt to define aging is impossible.

From what has gone before, I think that it is clear that anything that is being said at the moment is simply a statement of faith and beliefs. Somehow I believe that this question and consideration of the question, What is aging? indicates a bit the adolescent state of our present science. It reminds me somewhat of the discussions of "What is life?" I think that biologists some years ago gave up the attempt to define life. Nevertheless there has been a great deal of biologic research. Consequently, I am not convinced that an attempt at a definition of aging as a concept is particularly fruitful as long as it does not have an important bearing on the accumulation of research results.

However, I presume that those of us who were asked to participate in this program were invited because of our activities in research programs and that the assumption is that one does not engage in research unless one has some beliefs about the problem. It is also quite apparent that one's beliefs are going to be influenced in large measure by one's experiences and one's training. Consequently, what I shall make as a number of statements will be largely an influence of my background, my experience, and my training.

In the first place, it seems to me that the problem of aging is the study of changes that take place in time. I would not be willing to accept some of the definitions that you have already heard, that these changes must always be in the nature of loss of function. I think that is a question for investigation.

Furthermore, I would make as a second statement that we must always specify what it is that is aging. We have a good many levels in terms of complexity of the problems of aging. I would not be willing to accept any one of those levels as being the problem of aging. I think we may, first of all, consider as age changes, changes that occur with the passage of time, at a cellular level. We may also consider how tissues change.

The next step in terms of complexity seems to me to be that of alterations in functional capacities of various organ systems.

Finally, we have a more complex problem, namely, how do various organ systems correlate and integrate within an individual organism?

I believe that an additional area of importance is represented by the interactions between organisms: in other words, the social and psychologic reactions between people.

My third statement would be simply that I am not at all sure that there is an underlying process that is common to all of these areas. We already know, I think, that there are differences in the changes with time, or aging, in animals of various species. Some of the papers reported at this Congress indicate clearly that some animal species do not show what we call, in the mammal, degenerative changes.

My fourth statement is that I believe we need research at all of these levels. Let us suppose for the moment that we knew what the fundamental biochemical changes were in cells and that we knew the general process of aging at that level. Let us further suppose that as a result of research we found a substance, X, which would prevent the changes that we have described, on a cellular level, as age changes. I believe that we would accentuate many of the important problems in aging which must be solved by research at a different level of activity.

What, then, do we regard as the ultimate goal of research in aging? My own belief is that the ultimate goal of research in this field is to enable human individuals to live happier and more useful lives. If that is a goal, we must recognize the necessity for research in all of these areas. What we need most, I think, is more enthusiastic research, seasoned with tolerance and humility.

Thank you. (Applause)

CHAIRMAN COWDRY: Dr. Robert Moore.

DR. R. A. MOORE: Mr. Chairman and Ladies and Gentlemen: A pathologist, I suspect, is a very poor person to attempt any answer to the question, "What is aging?" and that is particularly true of a part-time and "would be" pathologist.

This problem of "What is aging?" comes essentially, at least to a pathologist, to a distinction between aging and disease. There is perhaps an even more fundamentally related problem than that, namely, the difference between physiologic processes and pathologic processes. To cite an example, some years ago I was interested in the effect of estrogens on the secondary male sexual organs and injected some estrogen into rabbits. One of the most beautiful pictures of acute inflammation with exudation of polymorphonuclear leukocytes that I have ever seen was produced, by nothing but estrogen, on the urethras of the rabbits. If you wish an example of edema, dilatation of blood vessels, migration of polymorphonuclear leukocytes through the epithelium, margination of leukocytes in blood vessels, just take a rabbit and inject a goodly dose of estrogen into him and section the urethra.

Is that inflammation in its usual sense or should you designate it as something different and call it physiologic inflammation? Certainly it is not provoked

by the sort of thing that we ordinarily conceive of. But I wonder how many other similar processes go on in the body that we call pathologic which are related to it, for example, in another field that has interested me, nodular hyperplasia of the prostate (benign hypertrophy of the prostate, as it is usually called). In this disease, throughout the stroma of the prostate, particularly the nodules (hypertrophic tissue, hyperplastic tissue) there is a considerable amount of lymphocyte infiltration, or, let's say more specifically, there are a significant number of lymphocytes throughout the stroma of that gland. A great deal of it is arranged in the form of lymphoid tissue; some of it is in the form of lymphocytic infiltration.

That is designated by most people, and certainly the great majority of urologists so look upon it, as chronic prostatitis. But when we remember that in hyperplasia of the thyroid, for example, in man there are immense lymphocytic aggregates, I am not at all sure you can look upon that as an inflammatory process. I believe you must regard it as a part of nodular hyperplasia of the prostate.

Then perhaps one can make another approach to this problem. Being a little mathematically-minded, I remember talking to Dr. Cowdry one time about this aspect of the problem: just arbitrarily saying that if some anatomic change (or physiologic, if you wish) in the tissue (I am thinking largely in terms of anatomic) occurs in 51 per cent or more of individuals, it is not a disease process but is an aging process, or a physiologic process, or whatever you wish to call it.

Not having any idea what aging is, if I were forced to select one thing at the moment, I think I would probably select the preceding as representing changes that occur with increasing age, in tissues, that is, if it occurs in more than 51 per cent. This disease of nodular hyperplasia of the prostate would then be an aging process, because, if you section the prostates of people over 80 years of age, you find that 75 per cent of them have developed nodules: nodular hyperplasia in their prostates. Yet, as a physician, I cannot give up the idea that nodular hyperplasia of the prostate is a disease, because it brings too many people over the age of 60 into the hospital for a major surgical procedure.

That, Dr. Cowdry and ladies and gentlemen, is about as far as I, as a pathologist, can go on this topic. I have given a lot of thought to it because of my interest in the prostate, in the fact that here I am dealing with a disease that occurs in 75 per cent, not all at a clinical level but certainly a significant number at a clinical level.

As I say, I don't know what aging is; but if I were forced to select something, I would say that any anatomic or physiologic change which occurs in human beings, under the conditions under which we are living, in more than 51 per cent of the people represents aging. Now, if we change the conditions under which we are living, we might very well change what we call aging. To carry it to absurdity, let us say that if the human being were to stop eating spinach, which would not be any great loss as far as I am concerned, and he did not develop nodular hyperplasia of the prostate, that would be a condition under which we are living which regulates what occurs in our tissues with increasing age. Any definition that we give to aging must be modified, as I see it, by the idea under the conditions of life as they exist at the present time. (Applause)

CHAIRMAN COWDRY: Gentlemen, the next speaker on this panel is Dr. Henry S. Simms.

DR. H. S. SIMMS: The word aging used in the sense of senescence or gerescence, if you want to coin an unneeded word, is a matter of considerable importance to all of us, but our conception of aging depends on our point of view. If four children were taken up to the zoo in Forest Park and were asked afterwards what the zoo was, one of them might reply that it was a place where they keep monkeys, another that it was a place where they keep lions, a third that it was a place where they keep bears, the fourth that it was a place where they keep birds. It would depend on their points of view.

So it is with aging, or senescence. To the teenager it is something that cannot happen to him; to the person entering middle life it is the beginning of loss of ability, and later loss of hair or of hair color, loss of skin tone, development of wrinkles, and the other symptoms that we are familiar with, gradually coming on until we become old people. Hence, aging is a group of processes resulting in numerous manifestations of different importance to different individuals.

One of the most important manifestations of aging is the progressive increase in death rate with advancing age. As we grow older, our probability of surviving another year decreases, gradually at first, but the rate of decrease increases as we grow older. In other words, the older we are, the greater the change in the mortality rate.

In regard to the relationship between degenerative disease and age, which Dr. Lansing mentioned, we know that the majority of deaths among older people are caused by a group of diseases which are mostly cardiovascular and renal, but we also know that age plays a role in the probability of dying from these diseases. The progressive rate of increase in death rate cannot be accounted for on an annual basis. The curves are logarithmic, and age plays a role in the increase in death rate. At the present time we don't know how it plays a role, but we know that it does.

So, too, with loss of ability, physical and mental.

These are manifestations of great importance from an economic standpoint.

In other words, to summarize my own conception of aging, it is a group of complicated processes resulting in varied manifestations that are important to all of us, some of us being more interested in some manifestations than others, but I think all of us are interested in the problem as a whole. (Applause)

CHAIRMAN COWDRY: Now, these definitions, or these attempted definitions, are very interesting. As you or I try, in our minds, to frame a better one, we have the feeling that each one of these has advantages and that, if one could only bring them together, we would perhaps be grasping a really concrete view of the situation.

There is one thing that I should like say, however: that I don't agree with Dr. Shock. I don't think we should approach this problem with humility. I think that we in aging have altogether too much humility. We ought to approach it with a measure of determination and fire, and a belief that what we are trying to do is really worth while and that we are getting there.

The problem, then, is to clarify our minds as best we can, and these gentlemen have exposed their minds to you. It is up to you, if you wish, to ask questions; to tear them limb from limb, if you wish to. I think there are some things besides humility that bear looking into very closely. So we will ask for discussion from the floor, which will be most welcome. Before doing so we will hear from Dr. Korenchevsky.

CO-CHAIRMAN KORENCHEVSKY: Apparently it will be more honest to admit that at present we cannot define accurately what aging, senescence, and senility are. At present they consist of a syndrome of two kinds of processes: (1) of the basic processes of aging, produced by basic causes, both of which so far are completely unknown to us; and (2) of so-called chronic or degenerative diseases of old age, such as arteriosclerosis, hypertension, effects of improper nutrition; accumulation of, and autointoxication with, metabolic waste products or with those of gastrointestinal autointoxication; certain so-called senile disorders of the heart, kidneys, liver, glands of internal secretion, and other organs and tissues, effects of infections and of mental and physical strains, et cetera.

These senile changes are secondary processes of aging, and they are produced by secondary causes of aging. They should be defined as secondary ones, because even now they are not present in all old persons and therefore most probably they are not necessarily associated with normal physiologic old age. It is obvious, however, that all these secondary senile diseases accelerate and badly complicate normal old age, making it premature and pathologic. They are responsible for increasing wear and tear of our organs and tissues. In fact, the present old age is a disease, and not a physiologic process.

Therefore, at present, gerontologists must unavoidably be satisfied with a definition which disregards the most fundamental fact: namely, that we do not know the causes, features, and standards of normal physiologic senescence. It can be expressed only in terms of the processes (effects) of aging as we can observe them now.

From the point of view of these requirements, the best definition of aging has been given by Professor Warthin (1929, p. 74). He constructs it on pathologic and clinical observations which have been obtained by all the investigators of the subject; namely, it is agreed that hypoplasia, or atrophy of organs, is one of the most important and typical changes and features of aging. Hence Warthin defines aging as a major involution of the living organism, of all its organs, tissues, and functions.

Since all of them are correlated with and dependent on each other, the involution of each single organ, "once well initiated, may through the weakening or loss of the given function initiate or strengthen retrogressive changes in other organs. The various lines of involution are not wholly independent, but, in the general economy of the organism, aid and supplement one another until various vicious circles and correlations of retrogression are produced." Although this definition deals only with the simplest factual effects of aging, it is very helpful in indicating various urgent schemes of gerontologic research.

That, it seems to me, is the best definition of aging. (Applause)

CHAIRMAN COWDRY: We had reached the point where we have invited criticism and suggestions from everyone here present, and I think that has started.

Weren't you going to say something? I think you had something on the basis of bacteria populations, Dr. Spencer.

DR. R. R. SPENCER: I merely want to briefly elaborate on the point made by Dr. Simms. I think that this question of aging depends largely on your point of view and your frame of reference or mental stance, if you will. We know that one needs to be specific in discussing this problem. When you say aging, aging of what? Are you talking about a cell, are you talking about a group of cells, or tissues, or a specific organ? Are you talking about an individual? Are you talking about populations? Or are you talking about some specific species?

We know that species vary tremendously. There are species, individuals of which live 24 hours, such as the May fly; there are others that live 5000 years. So I don't think you can discuss the problem as a

whole but have always got to get down to brass tacks and say, "Aging of what? What unit of life, what level of life, are you talking about?"

CHAIRMAN COWDRY: I think your point is a good one.

Is there some further discussion? Dr. Gey might have something to say about aging from the point of view of tissue cultures.

DR. G. O. GEY: There is not a great deal that I can add to this except to say that when one does come down to brass tacks, as Dr. Spencer says, it means cutting the organism into pieces, if one operates in the field of endeavor that we have been engaged in for so long. And here, to do a decent job, one must subject cells to conditions which favor activity. This was indeed the procedure that was classical for our field of research; but after this Congress and as a result of much reflection in the past, especially in the near past, we have become more courageous and have thought of other procedures which might throw light on the subject. That is the evaluation of cell responses under the conditions under which the cells are found in the advanced years.

I am reminded of an experiment which I started with Dr. McManus some years ago when we attempted to evaluate the proliferative capacity of epidermal cells in young and very old individuals. The conditions of those experiments were very simple indeed. We constructed a piece of equipment which would allow us to produce minute wounds in the skin before the skin was removed from the body, and then subjected this explanted tissue to a tissue culture system where we could observe the rate of proliferation of the cells in the wounded area.

Now, if one is going to come down to brass tacks, submitting these cells to specific conditions in vitro cultivation gave us one answer, and that is that the elderly individual can heal his superficial wounds as rapidly as can a young individual. This would simply indicate, it seems to me, that these cells, at any age, are capable of responding to the stimuli which we provided—these, however, not being those existing in the organism. Yet I would dare say that an individual who shaves, whether he be young or old, could heal his superficial wounds equally well.

Another point bears on this, and that is that the subjection of animals to severe low-temperature conditions also allows for rather good healing.

However, the skin of the elderly individual is definitely atrophic, as our histologists and pathologists would tell us. That, however, carries us into another field where we must examine the activities of cells of another type which act as a supporting structure to those cells about which I have just spoken.

In brief, therefore, we can say that if one attempts to evaluate aging at the cellular level in terms of dynamic responses, one must be highly specific and specify a one-cell system without consideration of the effects of other systems upon that system. However, one can easily, in a test tube experiment, control these factors, and thereby get some information as to whether or not in aging the so-called milieu exterieur does affect the well-being of the cell. (Applause)

CHAIRMAN COWDRY: Dr. Jalavisto, have you got anything to propose?

DR. E. JALAVISTO: I should just like to point out some aspects which, though they don't give us many practical hints, I believe we should think of.

First of all, the problem must be handled in two ways, that is, from the quite practical side and from, so to say, the philosophic side.

An individual's life is not anything that is static, but rather it is a dynamic whole. Its limitations, of course, are spaced in time, and somehow it must come to its end. As that end approaches, there are signs of disability.

Again, if we try to go into that problem in a practical way, the question of what are the signs of this approaching disability depends entirely upon the tools of study that we use.

There is a Finnish proverb which says, "As you shout in the forest, so it responds."

So I don't think that we can come to a conclusion that this or that has an important meaning in aging. We just can say that, if we study an individual as a whole, we may, with this special method, get certain results. I cannot say any more. (Applause)

CHAIRMAN COWDRY: Are there remarks from the floor? We shall be happy to have them.

DR. W. KAUFMAN: I have an objection to the 51 per cent, Dr. Moore. If we used that criterion and went back into history, we would find that smallpox was a normal aspect of aging, and we would find that lupus pox was a very important part of aging. I also think that one has to be very careful in setting up conditions so that they are both necessary and sufficient conditions, so that there is a 100 per cent correlation which is real. Even then, there are troubles. From about 1890 to 1900 for every member that was admitted to Tammany Hall's organization, there was a death that occurred in the province of India. The correlation was 100 per cent, but there was absolutely no direct connection.

Also, I think that aging is not necessarily a continuing process having the same velocity at all times, and that it undergoes acceleration at times but also remissions. I think it is the remissions that we see, apparently, clinically that offer a clue and a hope that we may be able to reverse the process of aging.

DR. O. J. POLLAK: I should like to emphasize one point that has been made here but in different words. We have to differentiate normal aging, or physiologic, from pathologic aging.

Can we stop the normal aging process? I don't

think so. Do we want to stop it? No. Do we want to slow it down? Yes. How?

I don't believe that that is a medical problem. We have here a section on biology and medicine. It is a biologic problem; it is a social problem. We know that we can slow down quite considerably, not only medical but anatomic aging, too, by prolonging the gainful employment—the stretch of gainful employment of our population. Now, that is the problem for the economic authorities, the psychologists, and so on, but not for the medical men.

Now, we have the medical aging, the abnormal pathologic aging. That definitely is our problem, and I speak now as a physician. We have to study the normal aging processes, no doubt. Otherwise we would not understand the pathologic processes. We must do so from all points: chemically, physically, anatomically, and so on.

Then we come to Dr. Shock's topic, the definition of gerontology, and I hope that at least we all understand that definition.

CHAIRMAN COWDRY: We have been discussing these problems for some time now. I wonder how much we are agreed upon them.

It has been said that we should regard the processes of aging, as far as we are concerned, as not starting with conception but as starting with the down swing after the peak of life. That was Dr. Lansing's view. Are there any supporters for that view?

You (addressing Co-Chairman Korenchevsky) are suggesting somebody to support it, and the person does not look as if he wanted to support it.

Are there any other matters that we can agree upon here?

I think that it is most important to distinguish the processes of aging, whatever they are, from disease processes, if we can. Consequently, normality comes into the picture, and we have to consider as normal the condition which is manifest in over 50 per cent of a group, the group being homogeneous and the environmental conditions being the same as far as possible. That was what Dr. Moore brought up.

We proceed, of course, to other points. It is obvious that when you are talking about the aging of cells, if you are using this word aging as most people do, as ending in death, that is not applicable, because a great many cells of the body don't terminate with the death of those cells. They terminate only with a division of those cells. Those cells lead intermitotic lives. They do not show the processes of aging as other cells do. If we are going to study the processes of aging, we ought to study them in the cells which die, not the cells which live and split into two daughter cells, such as those that form the layer that is concerned with replacement of epithelial cells all over the body.

Are there any views that the members of our panel want to present? If so, we would be glad to hear from them.

Dr. Moore has a view.

DR. MOORE: I should like to discuss this matter that has been raised, of smallpox: because at one time or another it occurred in 51 per cent of the population, it is therefore a part of the aging process. I would not accept that any more than I would accept the idea that gastroenteritis in children is an aging process.

Perhaps I can explain why I would not accept that by attempting, perhaps an even more dangerous thing than to define what is aging, to define what is gerontology. I was out of the room when Dr. Shock spoke. I just got the tail end of his talk, but it sounded as though he had defined gerontology.

But in order to clarify the point, this matter of just any 51 per cent, I want to emphasize that we are dealing with processes which occur progressively with an increment of time. The increment of time rules out the acute infectious diseases, and the word progressively rules out the acute infectious diseases. I am thinking of something that builds itself up with an increment of time and does not fall off at the end, which would, of necessity, rule out most of the carcinomas, because most of them fall off, not all of them. Some of them continue in frequency until the end of life, but most of them fall off toward the end of life. The frequency is lower than it is between the ages of 50 and 60. We are dealing with processes, then, that occur progressively with an increment of time.

And I would add to that—as long as I am halfway out on a limb, I might as well get all the way out—we are dealing with processes which are primarily, but not of necessity, ones which pathologists ordinarily call involutionary or degenerative in nature. Some of them are apparently hyperplastic in nature by the definition I have given you.

CHAIRMAN COWDRY: Thank you.

Have we got some other ideas about aging?

DR. A. D. GLINOS: In taking Dr. Cowdry's remark, talking at the cellular level, that not all of the cells may be said to age, that is, that they don't die, I was wondering whether one could start from the protozoa, the lowest level of organization, and define them as not presenting aging phenomena and death, and see if, as we go up to the more complex levels of organization, aging and death occur. Would that be a general phenomenon?

I was under that impression until I talked with Dr. Spencer, and there the problem arose that in protozoan populations, carried under certain cultural conditions for a long time, death would occur. So there is aging and death, perhaps, in the entire population.

I was wondering whether Dr. Spencer would like to

elaborate on that. Also, does he know how that would fit in with this idea I had that as you go from the simplest to the more complex forms of life, aging and death of the organism occur?

If you take lower forms of life, they may be subjected to aging and death; but if an accident occurs which will force the animal to regenerate, then we have no death in the usual sense that we use the word, that is, a dead body. If you keep on cutting a protozoon in the middle, it will never die. You have two new individuals arising. That brings about the question of the reversibility of aging phenomena through cell propagation and regeneration. And, going a little higher in the mammals, is the aging process in the highly differentiated tissues of the mammals irreversible under all circumstances or there again may regenerative processes reverse aging?

In doing some experiments on the liver in the rat, we found that through the tissue culture technique which we devised, we could determine the growth potential of the normal rat liver as a function of the age of the animal; and the older the animal got, the lower the growth potential got. But when regeneration was induced by partial hepatectomy, the liver tissue which was left behind and which was tested three days after the operation, when there was a speck of regenerative capacity, was found to have a growth potential similar to the growth potential of the young rabbits.

We were wondering, of course, whether that was a phenomenon which would be confined to the time period at which a tissue was proliferated in vivo. So we investigated the growth potential of the same livers one month after regeneration in vivo had been completed, and at that time in the livers in the resting condition we found no cell proliferation. In this case again we found that the growth potential was almost to the level of the young ones, although it had somewhat decreased.

I was wondering whether members of the panel and others would like to comment on that.

CHAIRMAN COWDRY: I don't want to do most of the talking. Indeed I would prefer that others did it. But aging was defined in my moving picture definition as the failure of tissues to respond adequately to their environments.

I wonder whether aging can be defined as the failure in replacement of these tissues and keeping them up in their particular performance. You know, of course, that when a motor car grows old, certain pieces of it fail to perform. Perhaps it is the battery. You take out the battery and put in a new battery. We can't do that with a body. We can't take out a spleen and put in a new spleen. But there are many replacing mechanisms. Perhaps these replacing mechanisms are of fundamental importance to us here.

When one considers replacing mechanisms, I think it is necessary to try to see the whole picture. We are concerned with the replacement of all of the components of cell and body tissues, and we are just about in the position now where studies can be made of these phenomena by tracer work with radioactive isotopes.

But is aging due to inadequate replacement of functional mechanisms? Of course, if we replace them adequately, we might live to 150. But as a matter of fact, we don't. If we don't replace them adequately, we die.

Any suggestions?

DR. SIMMS: To continue what Dr. Cowdry was just discussing, the question of replacement or regeneration of tissue, that is a subject that was of great concern a number of years ago when almost every worker in the field had the idea that regeneration was the whole problem in senescence.

Again I come back to the question of point of view. If we want momentarily to narrow our discussion to the problem of increasing death rate with advancing age, then we must consider the fact that the death rate, for example, from diseases involving arteriosclerosis depends upon the progressive increase in accumulation of sclerotic lesions. Then, in the light of Dr. Cowdry's statement, the question is: does the progressive increase in rate of deposition of fat or accumulation of lesions depend upon failure in regeneration?

CHAIRMAN COWDRY: I think perhaps I did not make myself quite clear. I did not use the word regeneration. I avoided that specifically, because I did not want to bring in the question of cell division. I meant the replacement of components in the cells. For example, there are nerve cells that we know don't divide beyond a certain age, and we have a good deal of information about aging in nerve cells. I want to know about the ability of the aging cells and the aging body to incorporate into its substance protein, fat, carbohydrates, and various tracer elements to compensate for losses.

I think perhaps it would be nice to call on Dr. Sosa from Uruguay. He has been working on aging of nerve cells. Dr. Sosa!

DR. J. M. SOSA: I was asked in the Session on Aging of the Nervous System to say something about what was to me the most striking characteristic of aging in nerve cells from the structural point of view, from the cytologic point of view. I said, and I continue to think like this, that so far as accumulation of pigment is concerned, especially the lipofuchsin, the lipochrome pigment seems to be the most characteristic element representing aging in nerve cells and that modifications of all other structures, such as neurofibers, Golgi apparatus, mitochondria, and even

nuclear structures, seem to take a very secondary place.

Now, there comes the problem, given to us by Dr. Cowdry, about the adaptability: the gradual loss of adaptability of cells as being the basic factor in aging. Well, the accumulation of pigment inside nerve cells, and producing secondarily a series of variations in other cellular structures, may represent a real gradual loss of adaptability in nerve cells. But for me the most important thing would be: could we make this trouble reversible? And I don't mean just to take out the lipoid pigment or just to see if we can get the intimate process which results in the production and accumulation of pigment, and if we can reverse the problem. But I am afraid that this is something we are far away from yet. However, it is something we have to have in mind.

Does this deal with the membrane processes, some change in the membrane conditions? Well, we certainly don't know, but we have to keep all these possibilities in mind and see if we can do something. I don't mean in a general sense, but that we should know something more about the intimate process in order to do as much as we actually can do morphologically.

In summary and conclusion, we cannot say very much about what is aging from the cytologic point of view. We can only state what we see. We see the accumulation of pigment. We can see, in some cases, deficiencies in nerve cells. How many? The spinal ganglion cells have a division in aging, in some persons. It seems to be a direct division. In this case the division does not appear as a kind of regeneration. Because it is a very peculiar effect, we have difficulty in getting an interpretation.

Thank you. (Applause)

CHAIRMAN COWDRY: Ladies and gentlemen, I cannot help but think that failure to perform as a mature adult is really to be regarded as aging. That can be manifest in a great many different ways. We have thought of it on the cellular level. We have thought of it on the tissue level. We have to think of it also on the mental and psychiatric level—every level. But we are trying to see back in here if there are any fundamental changes that can be regarded as especially characteristic of aging.

It was thought, you remember, for quite a long while that decrease in water content was one of these properties. Then came along the work of Hastings and Lowry and other workers, who cast some doubt upon this view that decrease in water content was a fundamental change with age. I should like to inquire whether we have any further information on that which should be brought out.

(Co-Chairman Korenchevsky assumed the chair.)

CHAIRMAN KORENCHEVSKY: Would anybody like to say something on this subject?

DR. SHOCK: I should like to say that we do have some preliminary observations—the work is in progress—from an attempt to find out whether the distribution of water within the total human organism is altered in old age. The methods for that determination are not as accurate and precise as we should like. I think, however, that we can say, in terms of obvious methods, that we have as yet not found any evidence of major shifts in the distribution of water in older humans. The problem, I think, is one of considerable importance, and perhaps it is a matter of techniques available. But I can say to Dr. Cowdry that at the moment, at least, we have not found any evidence of dehydration in terms of the human.

(Dr. Cowdry resumed the chair.)

DR. SIMMS: To add further information in answer to Dr. Cowdry's question about water content, a number of years ago, an assistant of mine ran many determinations on human tissues, both pathologic cases and accident cases, obtained in the morgue in New York City. Analyses were made on voluntary muscle, heart muscle, kidney and spleen muscle; and in both sets of cases, comparing young adults with old adults, we found not a decrease in water in these tissues but a slight increase.

CHAIRMAN COWDRY: I don't know what your wishes are regarding the conduct of this meeting. It may be that you would like to be entertained by the Coca-Cola Company for a few minutes and then come back here for further discussion, or you may wish to go ahead with the discussion now. Those who want an intermission please indicate by raising their hands; those who don't want an intermission! An intermission is not desired. This enthusiasm is really most encouraging.

I was going to mention another feature of aging, because perhaps, as we consider the features of aging, we can better arrive at a definition of aging. The features that I wish to call your attention to are the modifications in speed of aging which are so characteristic. Some tissues age quickly, others slowly, and some individuals age very quickly, and others slowly. There is perhaps a heredity factor here. We don't know. But there can be an internal secretion factor.

In the case of progeria, I was wondering whether Dr. Moore would be willing to say a word about these young people who are really, from every appearance, aged when they are only just in their teens or thereabouts.

DR. MOORE: As far as I know, there are only a very limited number of studies on this type of individual. There happened to be one here in St. Louis several years ago that was studied by our Department of Pediatrics. Unfortunately, there are even fewer anatomic or physiologic studies on them.

I don't think we have any real idea of what is going on in this process of progeria.

DR. POLLAK: Mr. President, I have only one question. I know that there are 421 papers being presented at this meeting. I should like to know how many of those papers relate to colloidal chemical changes and changes in enzymatic activity.

CHAIRMAN COWDRY: That is a question I cannot answer. It is a question that those who helped to prepare this program in detail could answer. I think Dr. Lansing might be able to give us some notion.

DR. LANSING: I am afraid I can't, Dr. Cowdry. I am afraid there are only too few.

CHAIRMAN COWDRY: I am entirely in agreement, there are only too few.

But we must not get delusions of grandeur in that some of these problems are simple. Studying the dehydrogenase and the oxidase, and so on, in the cell, we must stop and think of how many different enzymes there are in a single cell. Perhaps we might ask our biological-chemical friends. They will look very startled and amazed that you should ask that question, and they will answer, "Probably 10,000." So there you have it! It is not easy.

I should like to propose something further here in the way of definition. It seems to me that perhaps one of the features of aging that should be included in the definition is decrease in responsiveness. I think that some of the organs of the body fail to respond to endocrine products although the endocrine products are in a concentration which produced a response in earlier years. I know that there is a failure in response of my ear, and I know that my tastebuds are fewer than ever before and that the fibers for temperature in my mouth are fewer than ever before. What I don't know is whether the decrease in ability to perceive changes is due to a diminution of a number of elements or whether the quality of the elements is changing for the worse.

Is there some enlightenment to be had from our panel?

There is some enlightenment back there.

DR. D. F. DAVIES: Mr. Chairman, this problem is one which I should probably not discuss, since I got in late and it is a little dangerous to speak of something that might have been said.

The question of whether the individual cells are actually functioning at the same level, at a greater level, or at a lower level, has been indicated to some degree by the results of our studies on kidney function changes with age. In this case the effective renal plasma flow (the effective blood flow, actually) to the kidney decreased with age at a rate which was greater than the decrease in the renal tubule's excretory capacity, that is, for diodrast. This, however, is also true for other substances. When the ratio between the effect of renal plasma flow and the tubular excretory capacity is plotted against age, it is found that the ratio decreases. If the ratio is inverted, it increases, obviously meaning that per unit of active tubular tissue, there is actually less blood flow contributing to that unit or gram or cell of tubule.

This is not a direct approach to the problem since we have not studied the individual reaction of the cells. But Homer Smith uses the tubular excretory capacity to mean tubular mass, and it is as close as we have come to the problem.

It is startling to think that the tubules, or the cells of the tubules, in old age may actually be working at greater capacity than they are at a younger age. It is still possible, of course, that at a younger age there is a reserve which is not called into play when the stress phenomenon of saturating the blood with diodrast or P.A.H. is put on it.

I should like to say one thing on an entirely different part of the problem while I am here. There are three words which seem to be bothering us. One is aging, one is normal, and one is disease, or pathology. I should only like to say, in case it has not already been said, that these words the anthropologist would probably call anthropomorphic. Nature, whatever that is, doesn't appreciate the difference between disease, aging, and normal. So whatever definitions we arrive at are not definitions of any real difference; they are only definitions which are arbitrary. If we want to take a definition of normal which is true in a statistical sense, such as that suggested by Dr. Moore, that is perfectly acceptable as long as everyone is willing to agree that arteriosclerosis and hypertension are normal phenomena. Many pathologists, I think, would not accept those so-called diseases or pathologic changes as normal.

On the other hand, we could define normal in a sense of deviation from health. In this sense, which may be more acceptable to more people, death itself would not be normal, since it is a deviation from optimal health.

Therefore the definition is arbitrary to my way of thinking. And if we must use the terms, I think it would be best perhaps, Mr. Chairman, if I may make a suggestion, that a committee be appointed to study the problem and to arrive at definitions of these terms in order to come to some agreement between the various members of the Congress. A committee, representing the different societies, might well study the problem over the period of a year and then perhaps extend the decisions, or at least the discussions, to the entire group.

Thank you.

CHAIRMAN COWDRY: Ladies and gentlemen, I think that it would be a pleasing thing perhaps for you if we asked all of these gentlemen to come as

closely as they can to a statement of what aging is in from ten to twenty words. Let's have a little effort here. We will carry it on just a little further so that they may have a chance to pare down their statements of hundreds of words to ten or twenty words. Not to catch them unawares, perhaps I might give my own definition.

"Aging is the failure of tissues to respond adequately to environmental changes."

Do you want to come next, Dr. Korenchevsky? Ten to twenty words.

CO-CHAIRMAN KORENCHEVSKY: No.

DR. LANSING: I have one here in print, if I can just pick the right sentence.

"Senescence is decreased capacity on the part of the organism for self-synthesis."

This is an extension of Dr. Cowdry's remarks before. (Applause)

CHAIRMAN COWDRY: Dr. Shock, will you favor us?

You know what Lincoln said: "The briefest speech is the best speech."

DR. SHOCK: Well, I would simply reiterate what I said before. I should like to take the concept of "bad" out of the definition, and simply say that "aging represents the changes in function with time." (Applause)

CHAIRMAN COWDRY: Are you ready, Dr. Moore?

DR. MOOORE: Having had the honor and privilege of working with Dr. Cowdry for ten or twelve years, I worked this out about five minutes ago. No collusion whatsoever!

I don't think it is nearly as good as Dr. Shock's, but I don't agree with his either. Of course, he is a physiologist, and I am a morphologist. He said that aging was nothing but a change in function. What about all the structural changes?

DR. SHOCK: Do I have another word?

CHAIRMAN COWDRY: Yes.

DR. SHOCK: And in structure.

DR. MOOORE: I see.

Here is what I wrote down, anyway, five minutes ago: "Aging includes those processes which occur progressively with an increment of time and eventually affect over half of the units under consideration, which are primarily, but not exclusively, of a degenerative or involutionary nature, and which occur under a definite environment."

CHAIRMAN COWDRY: We are glad to have that definition, though I think it has a little too many words. (Applause)

I notice most of the other people up here are silent, particularly Korenchevsky. Can you get down to ten or twenty words?

CO-CHAIRMAN KORENCHEVSKY: If I were to say anything, I would only repeat the definition of Professor Warthin: that "old age is a major involution of the living organism, of all its organs, tissues, and functions."

CHAIRMAN COWDRY: Thank you very much. Some people have asked me not to call on them, but I am glad there are so many in the audience to call on. I hope they will volunteer their definitions.

DR. SPENCER: It is presumptuous of me to attempt any addition to what has already been said so far as definition is concerned; but while the discussion was going on, I could not help but make a couple of notes. I want to make at least two points.

If Dr. Cowdry's definition is right—and I think it is; certainly in part, in large part—that it is a question of decreased adaptation to the environment, then that means to me that there is really no difference, except in degree only, between aging and death. Death is complete failure to adapt.

Secondly, I think it ought to be pointed out that within any given species the well-known levels of organization differ in their life expectancies. Let's take the human species, for example. Surely the species lives longer than the component individuals. Even human institutions, which represent a higher level of organization than the individual, live longer. Individuals have a longer life expectancy than their component cells, and cells have a longer life expectancy than the self-duplicating genes within a cell.

It seems to me important to keep those things in mind when we are attempting to discuss this problem of aging.

Finally, I want to ask a question. I have never been able to accept the idea that single-cell species are immortal, or potentially immortal, because cell division and continuity of life does not imply, in my opinion, immortality of the original cytoplasm that is continued. It is a continuity, but it is certainly not immortality of the original cell. And yet ever since the days of Carrel, people have talked about the potential immortality of single-cell species.

Certainly we do know that in all single-cell species, in all populations of single-cell species, there are two processes going on: successive elimination and selective survival. And when a cell divides, there is no way to tell which is the mother cell and which is the daughter cell. It may be that those which die off early are equivocally analogous to the old cells, but we have no way of knowing. Are the cells which are formed equal in their potential survival when a cell divides?

Those are the only points I would wish to make. Thank you.

CHAIRMAN COWDRY: For my part I should like to say that I entirely agree with you about the cellular immortality business. The cells succeed each

other, but the individual cell has no immortality. Now, that was a nice concise definition in 275 words. Thank you very much.

DR. SPENCER: I did not attempt a definition. I was merely trying to add another thought.

CHAIRMAN COWDRY: I think you are right. I think you gave further modifications.

DR. JENSEN: I should like to modify Dr. Cowdry's definition a little bit for the following reasons: I do believe that there are other failures of adaptation besides those which we consider senescence. Also, as has already been stated, this failure of adaptation expresses itself not only in structures but also in function.

Therefore, I should like to express the definition of senescence as "a gradual and progressive failure of the adaptive processes of the organism."

CHAIRMAN COWDRY: I think that is a very good definition. Thank you.

Dr. von Albertini, would you favor us?

PROF. ALBERTINI: I would say "aging is a decrease of adaptation as a consequence of loss of tissue and functional reserves."

CHAIRMAN COWDRY: That is a very fine definition, in my opinion.

Are there some others?

DR. SIMMS: I have twenty-six words.

I would define aging as "a group of changes with advancing age, which are characterized by various manifestations, particularly loss of physical and mental abilities, and the progressive increase in mortality rate."

CHAIRMAN COWDRY: Any more definitions?

DR. M. GUMPERT: I would try to define aging as "a process in which more and more occurs for the last time, and less and less for the first time." (Applause)

CHAIRMAN COWDRY: Some other definitions? If there are any, we would be happy to have them.

DR. V. SUNTSEFF: During the meetings we were told about metabolic changes coming with old age, especially protein changes. I want to ask the members of the panel what they think about studying those changes. If we studied metabolic changes, not only in proteins but also carbohydrates, maybe we would get some clue to what the real answer is.

CHAIRMAN COWDRY: Does anybody want to answer that simple question? I can't. You know, I am a university professor, and I have had a long practice in trying to evade giving direct answers. And so I am not going to try to answer this one.

Does anyone want to answer this one? If not, the meeting is adjourned.

(The meeting adjourned at four-thirty o'clock.)

ORGANIZATION SECTION

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Program of the Fifth Annual Scientific Meeting of Gerontological Society, Inc.

In Joint Session with

The Division on Maturity and Old Age of the American Psychological Association

September 5-7, 1952

THE WILLARD HOTEL
Pennsylvania Avenue at Fourteenth Street
Washington, D. C.

Friday, September 5

10:00 a.m — Registration—Willard Hotel Lobby, Main Floor

1:30-4:30 p.m. — Tour of the National Institutes of Health (Buses will be at Pennsylvania Avenue entrance, Willard Hotel, at 1:25 p.m.)

1:30-4:30 p.m. — Joint sessions with the Division on Maturity and Old Age of the American Psychological Association — Willard Hotel, Congressional Room, Main Floor

1:30-2:30 p.m. — **Psychophysiologic Aspects of Aging**

Chairman: J. E. Birren

1:30 — KUMNICK, L. S., and MISIAK, H. — Pupillographic Study of the Psychosensory Restitution and Aging.

1:45 — COPPINGER, N. W. — The Relationship Between Critical Flicker Frequency and Chronologic Age for Varying Levels of Stimulus Brightness.

2:00 — OBRIST, W. D. — The Electroencephalogram of Normal Male Subjects over Age 65.

2:15 — JONES, H. B. — Some Early Circulatory Changes Associated with Aging.

2:40-3:40 p.m. **Productivity and Capacity of the Aging**
Chairman: R. W. Kleemeier

2:40 MILES, W. R. — Aging in Air Force Pilots as Studied by the American Institute for Research.

2:55 McFARLAND, R. A. — Psychophysiologic Problems of Aging in Airline Pilots.

3:10 BIRREN, J. E., ALLEN, W. R., and LANDAU, H. G. — A Theoretical Analysis of the Relations of Problem Length in Simple Addition to Time Required, Probability of Success, and Age.

3:25 CORSINI, R. J., and FASSETT, K. K. — Wechsler-Bellevue Age Patterns for a Prison Population.

3:50-4:50 p.m. **Creativity and Personality Changes of Aging**
Chairman: R. I. Watson

3:50 LEHMAN, H. C —. Man's Most Creative Years: Summary and Interpretation.

4:05 BROŽEK, J., and KEYS, A. — Personality Differences Between Normal Young and Middle-Aged Men: Item Analysis of a Psychosomatic Inventory.

4:20 WENAR, C. — A Comparison of Rorschach Findings on Aging Subjects with Their Psychiatric and Social Ratings.

4:35 BLAKE, W. D. — The Adjustment of Residents of a Home for the Aged.

Friday Evening, September 5

8:00-9:45 p.m. **Round Table: Factors in Counseling Older Persons** — Willard Hotel, Congressional Room, Main Floor
Chairman: O. A. Randall

Participants: J. Stieglitz, physician; J. Weinberg, psychiatrists; S. J. Korchin, psychologist; F. Fox, social worker; E. Shanas, sociologist

Saturday Morning, September 6

9:00-12:00 noon Meeting at St. Elizabeths Hospital (Buses will be at Pennsylvania Avenue entrance, Willard Hotel, at 8:55 a.m.)

9:30-10:00 a.m. Tour of the Hospital

10:00-12:00 noon **Processes of Aging** (at St. Elizabeths Hospital)
Chairman: W. Overholser

10:00 EPSTEIN, L. J., and NAIMAN, R. M. — An Analysis of Certain Life History Factors Associated with the Prevalence of Psychosis with Cerebral Arteriosclerosis.

10:30 KATZENELBOGEN, S., and FONG, T. C. C. — The Use of Metrazol in Arteriosclerotic Patients.

11:00 GERTLER, M. M., and OPPENHEIMER, B. S. — The Serum Lipid Pattern in Old Age.

11:15 CARP, L. — The Operative Management of Midthigh Amputations for Arteriosclerotic and Diabetic Gangrene. Analysis of 113 Consecutive Amputations in 108 Patients, 1939-1952.

11:30 LABECKI, T. D. — A Study of Serum Lipids in Arteriosclerotic and Apparently Healthy Subjects.

9:00-10:00 a.m. **Work and Retirement** (Joint Meeting with the Division of Maturity and Old Age of the American Psychological Association) — Willard Hotel, Crystal Room, Main Floor

Chairman: R. A. McFarland

9:00 SMITH, M. W. — Efficiency of Older Workers in Various Types of Jobs.

9:15 BOWER, J. — The Meaning of Work and Attitudes Toward Retirement of Older Workers in Retail Trade.

9:30 TUCKMAN, J., and LORGE, I. — Pressure Effect of Aging on Reported Work Performance.

9:45 ONODA, S. H., and GALLENBECK, C. B. — A Corporation Examines the Problems of Adjustment in Old Age.

9:00-10:15 p.m. **Care of the Aged** — Willard Hotel, Fairfax Room, Main Floor

Chairman: J. Weil *Moderator:* B. Grossman

9:00 YANACEK, D. — Factors in the Hospitalization of 100 Aged Persons.

9:15 OLSVARY, V. — Psychologic Aspects of a Survey of Elderly People in County Homes in Iowa.

9:30 BURKE, V. M., and GALPERN, M. — Organization and Management of the Extra-Mural Program of a Modern Home for the Aged.

9:45 PEARLMAN, S. L. — Benefits from Home Medical Service..

10:00 LAVERTY, R. — The Practice of Non-Resident Care for Elderly People.

READ BY TITLE: GOLDFARB, A. I. — Recommendations for Psychiatric Care in a Home for the Aged.

10:00-12:00 noon **Symposium: Concepts and Problems in the Study of Work and Retirement** (Joint Meeting with the Division of Maturity and Old Age of the American Psychological Association) — Willard Hotel, Crystal Room, Main Floor

Chairman: R. J. Havighurst

10:00 McCONNELL, J. W. — The Economic and Social Problems of Adjustment Confronting the Older Worker Today.

10:15 FRIEDMANN, E. A. — The Relationship of the Meaning of Work and Attitude Toward Retirement.

10:30 GINZBERG, E. — The National Implications of an Aging Labor Force.

10:45 **Panel Discussion:** Participants: C. B. Gallenbeck, L. S. Barrus, M. Barron, and J. Tuckman.

10:30-12:00 noon **Indices of Aging** — Willard Hotel, Congressional Room, Main Floor
Chairman: G. E. Wakerlin. *Moderator:* A. I. Lansing

10:30 LINDEN, M. E., and COURTNEY, P. D. — The Human Life Cycle and Its Interruptions; a Psychologic Hypothesis.

10:45 GINZBERG, R., and OLSVARY, V. — Life Span in Man and Vital Statistics.

11:00 RUDZINSKA, M A.. — Starvation and Longevity of Populations in Tokophrya Infusionum.

11:15 ANDREW, W., and KURTZ, S. M. — Cytologic Studies in Relation to Age: Some Observations on the Mitochondria and Golgi Bodies.

11:30 SORTER, H. — Liver Function in the Aged.

12:00 noon Luncheon Meeting, Council of the Gerontological Society — Willard Hotel, Executive Room, First Floor

Saturday Afternoon, September 6

1:30-4:00 p.m. **The Aging Processes** — Willard Hotel, Fairfax Room, Main Floor
Chairman: F. D. Zeman

1:30 LANDOWNE, M. — Age Changes in Living Arteries of Man.

1:45 ROGERS, J. B. — The Diagnosis of Spontaneous and Induced Tumors in Various Age Groups of Guinea Pigs.

2:00 SAUER, W. N. — The Importance of Common Ear Symptoms, Hearing Loss, Tinnitus, and Vertigo, as Early Indications of Beginning Geriatric Changes in Man.

2:15 PARFENTJEV, I. A., and WHITNEY, L. F. — Effect of Aging and Malignancy on Serum Protein Pattern in Dogs.

2:30 WALKER, J. M. — Blood Volume Estimation in Preoperative Preparation of the Aged.

2:45 KRAEMER, D. M., and MILLER, H. — Histologic Study of the Aging Human Aorta.

3:00 GERBER, I., STORCH, S., and ZEMAN, F. D. — Clinical and Pathologic Characteristics of Coronary Heart Disease in the Aged.

3:15 STORCH, S., and TANG, Z. T. — Cardiac Arrhythmias in the Aged.

3:30 PERLMAN, R. M. — The Aging Syndrome.

1:30-2:30 p.m. **Personality Potential of the Aging** (Joint Meeting with the Division on Maturity and Old Age of the American Psychological Association) — Willard Hotel, Crystal Room, Main Floor
Chairman: M. A. Seidenfeld

1:30 LAKRITZ, J. B., and FENSTERHEIM, H. — Psychoses and the Physical Rehabilitation of the Aged.

1:45 DONAHUE, W., HUNTER, W., and COONS, D. — The Effects of Activities Programs upon the Socialization of Residents of Old-Age Homes.

2:00 JOHNSON, G. H. — Differences in the Job Satisfaction of Urban Teachers as Related to Age.

2:15 McNULTY, J. P. — Case Studies of Well-Adjusted Persons over 70 Years of Age.

2:30-4:30 p.m. **Symposium: Community Mental Health for the Aging** — (Joint Meeting with the Division on Maturity and Old Age of the American Psychological Association) — Willard Hotel, Crystal Room, Main Floor

Chairman: J. Carter

2:30 STEVENSON, P. H. — Aging as a Public Mental Health Problem.

3:00 RANDALL, O. A. — The Problem of Programming for the Aging.

3:30 PRESSEY, S. L. — The Role of Psychologists in Mental Health Programs Concerned with Aging.

4:00 KAPLAN, O. J. — Research Needs in the Field of the Aging.

4:00 p.m. Business Meeting of the Gerontological Society, Inc., — Willard Hotel, Fairfax Room, Main Floor

6:00 p.m. Cocktail Hour — Willard Hotel, Congressional Room, Main Floor

7:00 p.m. Dinner, Gerontological Society, Inc. and the Division of Maturity and Old Age of the American Psychological Association — Willard Hotel, Congressional Room, Main Floor. Price $4.50

Status and Prospects of Research in Aging

Chairman: A. J. Carlson

Biological Aspects: R. A. Moore
Psychological Aspects: H. E. Jones
Sociological Aspects: E. W. Burgess

Sunday Morning, September 7

9:00-10:30 a.m. **Indices of Aging** (Continued) — Willard Hotel, Congressional Room, Main Floor

Chairman: E. V. Cowdry *Moderator:* W. B. Kountz

9:00 SHOCK, N. W., and YIENGST, M. J. — Basal Oxygen Consumption and Basal Respiratory Functions in Aged Males.

9:15 DAVIES, D. F. — Interrelationships of Certain Chronic Diseases with the Aging Process.

9:30 RUSK, H. M., and DACSO, M. — A Comprehensive Plan for Gerontologic Evaluation and Rehabilitation.

9:45 LEWIS, W. H., JR. — Differences in the Rate and Trend of Mortality for Different Age Groups in Different Eras.

10:00 BROŽEK, J., and KEYS, A. — Age Changes in Body Fat and Lean Body Mass in the Adult Man.

10:15 BOHATIRCHUK, F. — Some Micro- and Macroradiographic Aspects of Aging in the Bones of the Hand.

9:00-10:30 a.m. **Demography and Economics** — Willard Hotel, Fairfax Room, Main Floor

Chairman: J. L. Thurstone

9:00 SHELDON, H. D. — Changes in the Age Structure of the American Population, 1900 to 1950.

9:15 WILLIAMSON, W. R. — The Lengthened Life Line.

9:30 BALL, R. M. — How the Aged Get Along.

9:45 CORSON, J. J. — Taking Stock of Provisions for the Aged.

10:00 GINZBERG, E. — The Older Worker as a Marginal Person in Contemporary Society.

10:30-12:00 noon **The Aging Processes** (Continued) — Willard Hotel, Congressional Room, Main Floor

Chairman: N. S. Davis *Moderator:* J. E. Kirk

10:30 POMERANZE, J., MIGDEN, J. I., and DOBOVSKY, B. — Bromosulfalein Sodium Evaluation of Hepatic Function in the Geriatric Patient.

10:45 FAZEKAS, J. F., and BESSMAN, A. N. — The Effect of the Inhalation of 5 Per Cent CO_2 and Hyperventilation on Cerebral Vascular Tone in Elderly Patients.

11:00 PAPEZ, J. W. — A Study of Polyzoan Organisms in Brains of Young and Old Mentally Ill Patients.

11:15 KRAG, C. L. — Prevalence of Diabetes Mellitus Among the Aged. Results of Mass Screening Tests.

11:30 BERG, B. N., LESTER, J., and SIMMS, H. S. — Diseases of Old Rats.

11:45 SIMMS, H. S., BERG, B. N., and LESTER, J. — Mortality Data in the Rat as Related to Age.

READ BY TITLE: MANZONI, E., MORPURGO, M., RAVIZZA, G., RIVOLTA, A., and SCARZELLA, R. — A Clinical Study of the Platelets and of Biochemical Factors Related to the Blood Coagulation in Healthy and Diseased Old Subjects.

10:30-12:00 noon **Symposium on Education for Aging** — Willard Hotel, Fairfax Room, Main Floor

Chairman: W. Donahue

10:30 LINDEMAN, E. C. — Responsibility of Adult Education to an Aging Population.

10:40 HAVIGHURST, R. J. — Contributions of Universities.

10:50 RABE, H. — Experiments in Public Education.

11:00 DEMPSTER, H. — Industry and Business Experiments.

11:10 ANDRUS, R. — A College for the Aging.

11:20 LE MAIRE, H. — Educational Experiments with Institutionalized Older People.

11:30 LORGE, I. — Needed Research and Action Programs.

11:40 **Discussion.**

Sunday Afternoon, September 7

1:30-3:00 p.m **Indices of Aging** (Continued) — Willard Hotel, Congressional Room, Main Floor

Chairman: C. M. McCay *Moderator:* M. B. Visscher

1:30 BIRMINGHAM, M. K., and DESBARATS, M. L. — Respiration of Rat Thymus in Relation to Body Weight; Effect of Adrenalectomy.

1:45 GRAD, B., SHER, O., and SYMCHOWICZ, S. — Changes in Adrenal Cortical Function During Aging in Rats.

2:00 NORRIS, A. H., SHOCK, N. W., and WAGMAN, I. H. — Age Changes in the Maximum Conduction Velocity of Motor Fibers of Human Ulnar Nerves.

2:15 SIMONSON, E. — Effects of Moderate Exercise on the Electrocardiogram in Healthy Young and Middle-Aged Men.

2:30 MILLER, H., and KRAEMER, D. — Combination of Hydrochloric Acid and Sodium Hydroxide with Human Aortic Albuminoid.

2:45 BENDER, M. B. — Alterations in Perception in the Aged.

READ BY TITLE: MARS, G., and MORPURGO, M. — The Ophthalmoangioscopic, Craniologic, and Electroencephalographic Picture in Old Age.

MANZONI, E., MARS, G., RAVIZZA, L., RIVOLTA, A., SCARZELLA, R. — An Electrophoretic Analysis of Serum Protein in Healthy and Diseased Subjects at Different Ages.

1:30-3:15 p.m. **Retirement and Employment** — Willard Hotel, Fairfax Room, Main Floor

Chairman: E. Breckinridge *Moderator:* C. B. Gallenbeck

1:30 HEWITT, E. S. — Company Practices Regarding Older Workers and Retirement.

1:45 BARRON, M. L. — In-Plant Studies of Occupational Retirement.

2:00 WILSON, P. A. — A Vocational Counseling Program for Older Workers.

2:15 McKAIN, W. C., JR. — Worker Nostalgia—A Retirement Problem.

2:30 MOORE, E. H. — Company Programs of Preparation for Retirement.

2:45 BRITTON, J. H. — Work and Retirement for Older College Alumni.

3:00 WADE, L. — Medical Preparation for Retirement.

3:15-4:45 p.m. **Psychosomatic Factors** — Willard Hotel, Congressional Room, Main Floor

Chairman: J. T. Freeman *Moderator:* M. L. Reymert

3:15 TUTLES, A. J. — Importance of an Observation Period for Suspected Mental Cases in a Detention Unit of a Chronic Disease Hospital. Survey of 126 Cases Sent in for Commitment to a State Mental Institution and Their Final Disposition.

3:30 GOLDFARB, A. I. — Psychotherapy in the Aged. II. Utilization and Effectiveness of "Brief" Therapy.

3:45 STEINHARDT, R., ZEMAN, F. D., TUCKMAN, J., and LORGE, I. — The Evaluation of the Cornell Medical Index in the Study of Elderly Individuals.

4:00 TUCKMAN, J., LORGE, I., STEINHARDT, R., and ZEMAN, F. D. — Comparison of the Somatic and Psychosomatic Complaints of Institutionalized and Non-Institutionalized Older People.

4:15 BUSSE, E. W., BARNES, R. H., and SILVERMAN, A. J. — Conscious and Unconscious Influences Effecting Behavior in the Aged.

4:30 FROST, L. L., THALER, M. B., BUSSE, E. W., and SHY, M. — Rorschach Findings as Correlated with Physiologic Changes of the Aging Process.

3:15-4:30 p.m. **Social Adjustment** — Willard Hotel, Fairfax Room, Main Floor

Chairman: C. Tibbitts *Moderator:* R. G. Kuhlen

3:15 KAPLAN, J. — The Changing Perspective of the Public Welfare Agency in Planning for Its Senior Citizens.

3:30 WEBBER, I. L. — Recreational Activities of Older People.

3:45 SALAMONE, A. — An Experiment with Oldsters.

4:00 BEARD, B. B. — Life After 100 — A Study in Social Adjustment.

4:15 KAPLAN, O. J. — Effectiveness of Mailed Material in Inducing Older Persons to Obtain Chest X-Rays.

Reservations should be made as early as possible. The following is the schedule of room rates at the Willard Hotel, Pennsylvania Avenue at Fourteenth Street, Washington 4, D. C.:

Single rooms with bath, $6.00, $7.00, and $8.00 per day
Double rooms, twin beds, with bath, $10.00, $11.00, and $12.00 per day
All bedrooms and public space are air-conditioned.

Abstracts of Scientific Papers

A

Cytologic Studies in Relation to Age: Some Observations on the Mitochondria and Golgi Bodies.

W. Andrew *and* S. M. Kurtz, *Department of Anatomy, The George Washington University School of Medicine, Washington, D. C.*

The comparison of the mitochondria in a number of organs of young and old rats has been continued. Attempts to control the results of fixation to eliminate all factors causing differences except those of age have been made. The perfusion technique has been used, and its advantages and limitations are discussed.

The actual changes in the mitochondria, while difficult to describe in a quantitative manner, are consistently found as a feature of age in several organs. The liver particularly presents a greater heterogeneity in the mitochondrial pattern from cell to cell. In this organ the orderly pattern of evenly dispersed mitochondria present throughout the younger age groups gives way to a disruption of the intralobular arrangement, giving an appearance of loss of intralobular polarity. Coupled with this effect is an apparent change in the reaction of the tissue to fixation in that good preparations become increasingly more difficult to attain with advancing age.

Of special interest is the presence of pale-staining vesicles, apparently of mitochondrial origin, in liver and pancreas cells of old animals. This same phenomenon has been described by Payne in the thyroid, pituitary, and adrenal of the fowl, and by Jayne in the rat adrenal.

Some preliminary observations on Golgi bodies are given.

B

How the Aged Get Along.

R. M. Ball, *Bureau of Old-Age and Survivors Insurance, Social Security Administration, Federal Security Agency, Baltimore 2, Maryland.*

In November and December of 1951 the Bureau of Old-Age and Survivors Insurance made its first nation-wide survey of the resources of aged beneficiaries. A random 1 per cent sample of persons who had been awarded old-age or aged widow benefits and who were on the rolls in December, 1950, were interviewed in their homes. Approximately 18,000 schedules were obtained. Tabulation of the data is now in process and preliminary results will be presented in this paper.

The information furnished by the beneficiaries relates to the amount and sources of income received during the year preceding the interview; assets and liabilities, including the amount of assets used or debts incurred for living during the year; noncash income and public assistance received; and family composition, living arrangements, and number of persons dependent on the beneficiary.

Facts were also obtained as to the size of city in which the beneficiaries lived; life, accident, and sickness insurance carried; number of weeks confined to bed at home or in the hospital during the survey year; and the reasons for the retirement of the old-age beneficiaries, present attitudes toward employment, and the postentitlement employment and earnings of the beneficiaries.

The information gathered is representative of the approximately 2.8 million aged persons receiving old-age benefits in December, 1950, and who were still on the rolls at the time of the interview. In all probability it is representative in most respects of the 3½ million aged persons now on the old-age and survivors insurance rolls.

The data will be presented showing the amount and kind of resources beneficiaries have and how beneficiaries with inadequate resources manage, how many want to work and believe they are able to do so, how many apply for public assistance, and how many are partially dependent on adult children or other relatives.

The data presented will also present the number of beneficiaries who were hospitalized during the year, the extent to which these beneficiaries met medical expenses through hospital insurance, or other resources of their own, and the extent to which public agencies or relatives assumed the burden of their medical bills.

In-Plant Studies of Occupational Retirement.

M. L. Barron, *Department of Sociology and Anthropology, Cornell University, Ithaca, New York.*

A longitudinal survey of a nationwide sample of 64 year old employees in various occupations and industries has begun this year. The subjects are being interviewed and medically examined in their work or former work situations each year for seven years for the purpose of comparing the personal and social adjustment as well as the health of those who retire with those who continue in gainful employment.

Pre-tests among literate subjects using both the interview method and the self-administered questionnaire have suggested that the latter encourages considerably less inhibited responses. The older workers,

for example, have been more willing to identify themselves as "aged" or "elderly" and as being in poor health in the self-administered questionnaire than in the face-to-face interview.

Life After 100 — A Study in Social Adjustment.

B. B. BEARD, *Division of Social Studies, Sweet Briar College, Sweet Briar, Virginia.*

Analysis of case records of 200 centenarians shows this segment of our population to possess unique traits which predispose them for survival. The patterns of social adjustment shown through case studies of centenarians offer considerable insight into adjustment processes in general. This study of life after 100 at the middle of the twentieth century purports to be a basic study for subsequent comparative studies.

Alterations in Perception in the Aged.

M. B. BENDER *and* M. A. GREEN, *Department of Neurology, New York University College of Medicine, New York 16, New York.*

Different patterns of response to tests of simultaneous tactile stimulation have been observed in normal children, normal adults, and in patients with disease of the brain. In this communication we will report the responses to perceptual tests in elderly individuals.

Over 250 so-called normal adults in old age homes between 61 and 96 years of age were studied. The majority of these subjects showed some of the mental changes usually associated with senility. Those with severe mental changes or obvious focal neurologic signs were not included.

Two tactile stimuli were applied simultaneously to the face and the hand in each subject for a minimum of 14 trials.

Errors in perception were seen in all age groups. There was a direct relationship between age and the frequency of these errors. In the lower age groups many subjects made errors only on the initial trials. This type of response occurred less frequently in the older age group. Thus a larger number of the older subjects manifested persistent errors in preception during the entire series of tests. The error was found most often in the hand stimulus indicating dominance of the face over the hand.

The responses of "normal" seniles to simultaneous tactile tests bear a resemblance to those observed in normal children, age 3 to 6 years. In both groups the frequency of perceptual errors is related to age. In correlating the findings in a series of normal subjects from infancy to senility we find that the incidence of errors is greatest in the young child and in the old man.

Diseases of Old Rats.

B. N. BERG, J. LESTER, *and* H. S. SIMMS, *Columbia University, College of Physicians and Surgeons, New York, New York.*

Infections occur chiefly in the lungs as a chronic form of pneumonitis and bronchiectatic abcesses.

The neoplasms include various spontaneous epithelial and mesenchymal tumors. These are found in the subcutaneous tissues, mammary glands, thyroid, pituitary, adrenals, uterus, kidneys, and peritoneum. Primary growths are rare in the gastro-intestinal tract and liver. In the pancreas, however, adenomata derived from the islet cells are common. The incidence of different types of tumors varies with the strain of rat—the Sprague-Dawley strain being used in this laboratory.

Cardiovascular conditions and renal disease appear more frequently in the older rats. Changes in the heart include fibrosis, left ventricular hypertrophy, and thrombus formation in the left auricle. Significant alterations in the coronary arteries, or in the aorta and its branches, are rare. However, a form of periarteritis limited to the mesenteric vessels occurs frequently, appearing first in the pancreatic arteries. Electrocardiographic studies reveal a high incidence of left axis deviation. This runs roughly parallel with left ventricular hypertrophy. Various cardiac arrythmias also occur.

The kidneys develop a progressive degeneration of the tubular epithelium in a high percentage of the animals. The tubules become greatly dilated, while large cysts are formed, leaving relatively little normal parenchyma. There is also considerable scarring with loss of glomeruli, and the renal arterioles show varying degrees of sclerosis. Blood pressure observations on aging animals show that hypertension sometimes develops.

Respiration of Rat Thymus in Relation to Body Weight; Effect of Adrenalectomy.

M. K. BIRMINGHAM *and* M. L. DESBARATS, *Allan Memorial Institute, McGill University, Montreal, Canada.*

The rate of oxygen uptake of thymus suspensions in glucose-containing and glucose-free Krebs Ringer phosphate medium was determined in 47 male rats weighing between 25 and 450 gm. The respiration rate decreased as the body size increased and was less well maintained in the larger animals. The absence of glucose from the medium did not affect the respiration rate of thymus suspensions from rats under 50 gm., but became inhibitory as the animals increased in weight. There was also a significant positive correlation between respiration rate per unit weight of thymus and thymus weight in animals weighing over

200 gm., but not in rats weighing less, indicating that the respiratory activity of the thymus varied with its state of involution. Adrenalectomy, which caused an approximately twofold increase in thymus weight, was found to have no effect on the respiration rate in animals weighing between 50 and 225 gm.

(This work was supported by funds from the National Research Council of Canada.)

A Theoretic Analysis of the Relations of Problem Length in Simple Addition to Time Required, Probability of Success, and Age.

J. E. BIRREN, W. R. ALLEN, *and* H. G. LANDAU, *National Institute of Mental Health, Bethesda, Maryland, and the University of Chicago, Chicago, Illinois.*

Problem: The purpose was to interpret age changes in accuracy and speed of simple addition by means of a theoretic model. Such an analysis presumably would be of value in attempts to analyze age changes in the intellect.

Subjects and Materials: 413 subjects aged 16 to 90 years were given single column addition problems of varied length from 2 to 25 digits. Both the accuracy or probability of success, P, and the time per problem, T, were analyzed as functions of problem length.

Model: The time required to add several digits can be separated into three general components: (1) perception of the digits, (2) addition of each digit to the partial sum of digits previously added, and (3) writing of the answer. Assumptions about these classes of components permit derivation of a rational equation expressing time per problem as a function of the problem length; i. e., $T(n) = A + Bn + Cn^{1-k} + Dn^{2-k}$, where $T(n)$ is the total time for a problem of n addition operations.

Errors may be analyzed into four general components: (1) perception of the digits, (2) adding a digit to a partial sum, (3) carrying over a partial sum, and (4) recording the answer. Appropriate assumptions permit derivation of an expression for the probability of a correct answer to a problem of n operations in length; $P(n) = P_0 e^{-(c_1 n + c_2 n^2 + c_3 n^3)}$.

Results: Empirical equations used in fitting the data seem consistent with the rational equations and the model thus seems plausible.

Elderly subjects were slower for all lengths of problems and showed less accuracy than the young with increased problem length. Loss of speed is intimately involved in aging of the nervous system, thus elimination of time from psychometric indices would seem to neglect important psychologic and psychophysiologic data. Psychometric measurement in the elderly requires recording, independently, probability of success and the time required for the various task components.

The Adjustment of Residents of a Home for the Aged.

W. D. BLAKE, *Department of Psychology, Bucknell University, Lewisburg, Pennsylvania.*

The objective of the study is to collect material which may be useful in preparing individuals for aging and retirement. The subjects are 20 males ranging in age from 70 to 93 and 20 females aged from 60 to 85. The physical health of these subjects was above average considering their chronologic ages.

Personal interviews were scheduled with each of the inmates over a period of seven months, each person being interviewed several times, by which an excellent state of rapport was established. Two interviewers were used, one male and one female, each for the purpose of interviewing the members of his own sex. The questioning of the interviewers covered five areas of the lives of the subjects; previous work, social life before becoming a resident of the home, religious attitudes during early life, recreation during life outside, and general economic and family background. Information was also brought out as to the reasons for coming to the home. Much of the data procured were checked for general accuracy with the records of the home.

Each individual's contribution was analyzed for the purpose of discovering the attitudes or characteristics which might be an important feature of his adjustment. Also the group replies were examined to find the common features which might indicate those items important in adjustment.

As a result of the examination of all the data, the following common factors seem to be necessary to a happy old age adjustment to life: (1) hard work over long hours of time; (2) not over two or three social activities; (3) a religion-oriented life (organized religion). From a study of the data several inferences relative to a possible schedule of preparation for the coming of old age and retirement may be drawn.

Some Micro- and Macroradiographic Aspects of Aging in Bones of the Hand.

F. BOHATIRCHUK, *Department of Anatomy, University of Ottawa, Ottawa, Canada.*

Radiographic symptoms of bone aging in the hand mentioned by several authors will be summarized and an attempt will be made to differentiate these symptoms in physiologic bone aging from those in pathologic bone aging.

The author is not inclined to consider all the clinical and radiographic symptoms of degenerative osteoarthritis charactertistic for physiologic bone aging. In particular neither Heberden's nor Bouchard's nodes

nor their radiographic picture are typical for physiologic bone aging.

Several typical radiographic symptoms in the physiologic bone aging in micro- and macroradiography will be discussed and the author's technique of micro- and macroradiography will be presented.

The various stages of physiologic bone aging in different individuals require a further study regarding the possible correlation of aging of the bone, profession, climate, race, previous diseases, and heredity.

The Meaning of Work and Attitudes Toward Retirement of Older Workers in Retail Trade.

J. Bower, *The University of Chicago, Chicago, Illinois.*

A study was made of the meaning of work and attitudes toward retirement of 160 department store workers between the ages of 55 to 70. Half of the group was in sales work and half in sales-supporting occupations such as receiving-handling, inspecting-wrapping, and alterations work. Each group was made up half of men and half of women. Conducted in a Chicago department store by means of hour-long, confidential interviews, for the most part tape-recorded, the study investigates the hypotheses that (1) people in occupations requiring a low degree of skill will recognize and stress fewer values in work than will those in occupations requiring higher degrees of skill, (2) women will recognize fewer values in work than will men and will not stress those values they do recognize to the same degree as will men, (3) persons, regardless of sex, who strongly emphasize the values they recognize in work will not wish to retire at the age of 65, and (4) more women than men will express a willingness to retire by the age of 65.

Work and Retirement for Older College Alumni.

J. H. Britton, *Department of Psychology, Pennsylvania State College, State College, Pennsylvania.*

Investigations of the personal adjustment of older people have revealed that engagement in some form of gainful employment is a significant factor of good adjustment in old age, especially for men. This paper reports the findings of an investigation concerning attitudes and opinions about work and the significance of retirement to 362 male alumni of class of 1866 through class of 1913 of an eastern land-grant institution of higher learning. Questionnaires were mailed to each man on the rolls of the alumni association, and efforts were made to determine the representativeness of the responding sample, which constitued 20.6 per cent of the total mailing list of 1,757.

Data were obtained concerning opinions about work and retirement of these men, some of whom were still working as engineers, teachers, lawyers, farm operators, sales personnel, etc. Opinions concerning possible alternatives to arbitrary, compulsory retirement practices were secured. General conclusions are drawn regarding the relationships existing within this group in terms of opinions on work and retirement, personal adjustment, and present employment.

Age Changes in Body Fat and Lean Body Mass in the Adult Man.

J. Brožek *and* A. Keys, *Laboratory of Physiological Hygiene, School of Public Health, University of Minnesota, Minneapolis, Minnesota.*

The amount of "excess" fat, expressed as the percentage of body weight and estimated from specific gravity, and the thickness of skinfolds were determined in 5 groups of clinically normal adult men, with the average ages of 20.3, 25.2, 46.0, 50.0 and 54.6 years, and relative weight (actual weight as percentage of weight standard for height and age) approximating 100, with a range from 99.9 to 100.2. The average fat percentages were 9.9, 14.4, 22.2, 24.0, and 25.2. Fitting a parabola to these values we obtain the prediction equation

$$\hat{Y} = -5.55564 + 0.92836\ X - 0.006776\ X^2,$$

where $\hat{Y}$ is the "standard" fat percentage, and X is the age of a subject in years.

The increase in the amount of body fat from 20 to 55 years exceeds the increment of the gross body weight, indicating an actual decrement in the lean body mass. For individuals 176 cm. tall, the standard weights at the ages 20 and 55 are 67.6 and 76.8 kg., the standard fat 7.0 and 19.2 kg., the "fat-free" weight 60.6 and 57.6 kg. In general the subcutaneous fat paralleled the total body fat but the rate of increment in the thickness of skinfolds measured at different parts of the body surface varied considerably. The chest skinfold, measured above the nipple, reflected most closely the increment in total fatness.

Personality Differences Between Normal Young and Middle-Aged Men: Item Analysis of a Psychosomatic Inventory.

J. Brožek *and* A. Keys, *Laboratory of Physiological Hygiene, School of Public Health, University of Minnesota, Minneapolis, Minnesota.*

Problem: Maturity, extending roughly from 20 to 60 years of age, is a period of slow but not insignificant changes in man's body composition and physiologic fitness, in special senses and psychomotor functions. What kinds of changes take place in the personality of clinically normal individuals?

Subjects Used: The subjects were volunteers recruited from the University of Minnesota students and from local business and professional groups who enrolled in a longitudinal study on the aging of the cardiovascular system. The present report refers to observations made in the second year of the study. The men in the younger age group averaged 21.9 years (range 18 to 26, N = 119), in the older group 50.3 years (range 46 to 56, N = 200).

Procedure: The inventory, developed in this laboratory in cooperation with B. Joslin for the study of predisease personality characteristics predictive of essential hypertension, was patterned after the Minnesota Multiphasic Personality Inventory. Only the definite (Yes or No) answers were considered for comparing the frequency of responses in the two age groups. The number of uncertain (Cannot Say) answers was small (5 and 4 per cent in the case of items differentiating between the younger and older men at the 1 per cent level of significance).

Results: The 68 (out of 216) items in which significant differences in the frequency of positive answers were obtained were grouped under 7 headings: health, recreation and sports, home and family, self-confidence, emotional adjustment, interpersonal relations, and standards of conduct. The results, which will be presented in a form of tables, contribute to the characterization of aging in successful, healthy middle-aged men in a midwestern metropolitan community.

Organization and Management of the Extra-Mural Program of a Modern Home for Aged.

V. M. BURKE *and* M. GALPERN, *Social Service Department, the Home for Aged and Infirm Hebrews, New York, New York.*

For the past four years an Extra-Mural Care Program has been successfully operated under the auspices of the Home for Aged and Infirm Hebrews of New York in cooperation with the Jewish Family Service and the Central Bureau for the Jewish Aged. During this time 89 men and women including 26 couples and ranging in age from 58 to 88 have been served in their own homes. Extra-Mural Care is considered one of the integral parts of the Home and admission to this facility is based on a careful social and medical study of the individual. Every effort is made to extend the services of the Home to these people in the community and to extend to them the security that the institution offers to those in residence. Care in the client's home is furnished by visiting physicians, visiting social workers, visiting nurses, and visiting housekeepers. In addition the facilities of the institution itself are made available.

In its early stages, individuals admitted to the program were in the functionally independent group, but as experience has increased, more and more handicapped persons have been satisfactorily cared for. The results of our experience have shown this to be an effective method of expanding the influence and the accumulated knowledge of a Home for the Aged beyond its four walls, and goes far to meet the shortage of institutional beds.

Conscious and Unconscious Influences Affecting Behavior in the Aged.

E. W. BUSSE, R. H. BARNES, *and* A. J. SILVERMAN, *Division of Psychosomatic Medicine, University of Colorado Medical Center, Denver, Colorado.*

Approximately 200 subjects, divided into two major groups, were utilized for this portion of this investigation. The individuals studied were all over the age of 60, the average age being 74. The first group of elderly persons were composed of those who, on the basis of specific initial criteria, were considered to possess "normal mental facilities." Any disease present was minimal and not of central nervous system origin. The second group included those who showed evidence of mental changes, probably of organic origin, and who in many instances were hospitalized because of such symptomatology. Some of the interesting findings were as follows:

(1) The attitude and behavior of elderly persons in regard to their grown children is largely unconsciously determined and represents the end product of a life-long series of events which are largely influenced by dependency-hostility conflicts. There is a definite correlation between parental attitudes existing many years ago and the type of reaction which is now apparent between the grown child and the subject.

(2) Interest in sex is not lost and sexual frustration can be a very important anxiety producing factor, which is more apparent in elderly women than in men.

(3) There is a definite shift in religious activity, that is, less participation in church functions and attending church, but there is no apparent change from the belief in a deity. This shift is determined by both reality factors and the decreased need to atone for guilt, as elderly persons do not participate in many guilt producing activities.

This investigation was supported by a research grant from the National Institute of Mental Health, National Institutes of Health, Public Health Service.

C

The Operative Management of Midthigh Amputations for Arteriosclerotic and Diabetic Gangrene. Analysis of 113 Consecutive Amputations in 108 Patients, 1939-1952.

L. CARP, *Goldwater Memorial Hospital, New York, New York.*

This study has been made at the Goldwater Memorial Hospital in New York City in bad risk patients who were almost all in the older age groups and who were already hospitalized for degenerative diseases other than arteriosclerotic and/or diabetic gangrene of the lower extremities. They presented a number of important problems which have a direct relationship to morbidity and mortality. These problems included procrastination and timing of operation, technical methods with the least amount of trauma, indications for closed versus open stumps, anesthesia, especially the contraindicated crymal anesthesia with tourniquet, postoperative stump care, and supportive and nutritional therapy.

Many surgeons have elected to leave midthigh amputation stumps open and apply traction because they feared infection and stump breakdown. However, our statistics show that in those patients without obvious ascending infection or marked thrombosis of the femoral vessels, results will be good when the stumps are handled by tight or loose closure, depending on the judgment to be used in each case. This is especially true since the advent of chemotherapy and antibiotic therapy. The advantages of this procedure are a better end-bearing stump, minimal pain and healing time, a better maintenance of chemical balance, less chance for secondary hemorrhage, and better morale for the patient.

Technical methods must be gentle and produce the least amount of trauma on tissues which have a circulation which is severely compromised and in which there may be infection in the lymphatics and blood vessels. These methods are discussed. Crymal anesthesia with tourniquet is contraindicated because it predisposes to massive thrombosis and stump breakdown. Oral food and fluid intake must be adequate. The clinical causes of death and observations at autopsy are discussed.

The Relationship Between Critical Flicker Frequency and Chronologic Age for Varying Levels of Stimulus Brightness.

N. W. COPPINGER, *Veterans Administration Center, Wadsworth, Kansas.*

The purpose of this research was to establish the functional relationship between foveal CFF and age under different conditions of stimulus brightness.

One hundred and twenty white males, ranging in age from 20 through 79 years, were selected from the patient population of two hospitals. They were screened for physical disease known to alter CFF and were free of gross visual defects.

The stimulus light was produced by an episcotister with a 1:1 light-dark ratio. The light system was operated on direct current. The stimulus field was a square of diffused constant light in the center of which was a circle of intermittent light. The total stimulus field subtended a visual angle of 1 degree, 56 minutes. CFF was defined as the average of four ascending and four descending judgments at each of three levels of stimulus brightness (0.0912, 0.5388, 1.742 mL.)

The functional relationship between foveal CFF and age was found to be linear and negative. The form of this relationship has all of the characteristics of the decrement in the curves which describe the relationship between age and other sensory and motor functions. The rate of decay of the CFF-age curve increases when the level of stimulus brightness is increased. The slopes of the foveal CFF-log brightness curves are less accelerated in older subjects and add further evidence that the extent of the age decrement in CFF is dependent upon the level of stimulus brightness at which the measurements are made.

Since many of the physiologic changes associated with aging are qualitatively similar to diseased and artifically induced conditions which lower CFF in young persons, a single factor explanation for the physiologic mechanism underlying the decrement of CFF among older persons is meaningless. To properly understand how this decrement occurs research must be directed toward uncovering the extent to which one organ-system alteration contributes to the total decrement.

Wechsler-Bellevue Age Patterns for a Prison Population.

R. J. CORSINI *and* K. K. FASSETT, *Wisconsin Department of Public Welfare, Madison, Wisconsin.*

A number of investigators who have studied the patterns of intelligence of large samples of individuals in terms of age have concluded that intelligence declines after the age of 30 at a steady rate.

The hypothesis that we have taken is that the conclusions of these studies are wrong and that the drop in scores of older people can be explained in a number of alternate ways including poor sampling, motivational differences, and the influence of physiologic artifacts.

The subjects used were 1072 incoming prisoners at San Quentin to all of whom the Wechsler-Bellevue (I) was given. The sample includes exactly 100 subjects for each five-year period starting with age 15-19 to 55-59 and 172 people older than 59. This is the largest sample reported of older people on an individual intelligence test.

The weighted scores of these 12 samples of subjects for each of 10 sub-tests are averaged, and trends are obtained.

The results are unequivocal: all verbal tests hold well, and some of them actually show a steady increase from early to late maturity: all timed and

performance tests show a steady drop with age.

Conclusions are:

1. Intelligence does not decrease from early to late maturity.
2. Tests free of speed, vision, and hearing hold well.
3. Verbal tests which included material that is accreted during life actually show improvement.
4. Tests which involve speed and vision and close attention drop rapidly.
5. For the purpose of inter-age comparisons of intelligence, only tests free of emotional, cultural, and physiologic artifacts should be used.

Taking Stock of Provisions for the Aged.

J. J. Corson, *Pensions and the Aged, Twentieth Century Fund, New York, New York.*

National attention since 1935 has been focused on providing income for a growing body of aged people. How far have we succeeded in achieving this end? What more is needed? Has this nation reached the state when retirement is feasible for approximately one-tenth of the population? Can we provide the social arrangements required to integrate that tenth of what has been a work-connected society?

D

Interrelationships of Certain Chronic Diseases with the Aging Process.

D. F. Davies, *Hypertension Division, Department of Internal Medicine, Washington University School of Medicine, St. Louis, Missouri.*

The question is often asked whether a particular disease predisposes toward another or is negatively correlated with it. Examination of this problem requires availability of reliable records from a large population and proper statistical analysis. Discharge diagnoses of 16,843 patient-admissions to the General Medical Service of Barnes Hospital were studied. Pertinent data coded on IBM cards were analyzed by sorting and counting machines and by proper statistical procedures.

The percentage incidence of hypertensive vascular and cardiovascular disease was 15.9; coronary thrombosis and myocardial infarction, 3.97; asthma, 3.32; rheumatoid arthritis, 2.58; diabetes mellitus, 7.23; and obesity, 5.79. The ratio of distribution between males and females was: hypertension, 1.01; coronary thrombosis, 2.93; asthma, 0.835; arthritis, 0.579; diabetes, 0.875; obesity, 0.458.

Chi-Square analysis showed the following highly significant positive correlations: hypertension and coronary thrombosis in both men and women; hypertension and obesity in both men and women, and diabetes and obesity in men, but not in women. Combined diagnoses were observed significantly less often than expected in men with hypertension and asthma, both sexes with hypertension and arthritis, men with coronary thrombosis combined with asthma and with rheumatoid arthritis, both sexes with diabetes and asthma, and women with diabetes and rheumatoid arthritis.

From comparison of age profiles of the hospitalized patients and of the general population, a smooth curve, which may be used as an index of morbidity, has been derived. It indicates a constant decrease in resistance to disease during adult life.

The Effects of Activities Programs upon the Socialization of Residents of Old Age Homes.

W. Donahue, W. Hunter, *and* D. Coons, *University of Michigan, Ann Arbor, Michigan.*

The principal objective of this study was to test the hypothesis that participation in activity programs designed to conserve and use personal resources will improve the adjustment of people living in homes for the aged.

A study was made of 14 old age institutions housing 835 residents from which an experimental and a control group of homes was selected by matching according to size of total resident population, types of individuals served, average age of residents, and existing activity programs.

A pre-activities assessment of the adjustment status of the residents was obtained in the two control and two experimental homes, as measured by (a) a sociometric scale, (b) the Burgess, Cavan, Havighurst Attitudes Inventory, and (c) personal interview. The study population was selected to include only those residents in each home who were ambulatory and physically and mentally capable of participation.

The activities program period of eight months' duration followed the preliminary assessment immediately in the experimental homes. Nothing further was done in the control homes during this phase of the study except to make periodic visits to insure that significant changes in home circumstances were not taking place.

In the post-activities period another assessment of the study populations in both the control and experimental homes was carried out by administering the same measuring devices used in the initial assessment.

Data will be presented indicating (1) increased sociability among the experimental home residents and (2) decreased group interaction among the control-home residents. Results of the Chicago Scale will also be reported.

E

An Analysis of Certain Life History Factors Associated with the Prevalence of Psychosis with Cerebral Arteriosclerosis.

L. J. EPSTEIN *and* R. M. NAIMAN, *St. Elizabeths Hospital, Washington, D. C.*

This study, the first of a series on psychosis with cerebral arteriosclerosis, reports on certain life history factors and their association with the prevalence of this disease. The factors studied were education, occupation, and the extent of alcoholic indulgence.

The subject population included all white male residents (160) of Saint Elizabeths Hospital, Washington, D. C., with a condition diagnosed as psychosis with cerebral arteriosclerosis during a three year period. Their educational achievement was compared with Census Bureau statistics for District of Columbia white male residents 55 years of age and over. Occupational data were compared with District of Columbia male population 55 years of age and over, statistics for which have not yet been separated as to racial groups. Alcoholic consumption was compared with a World Health Organization report and Jellinek's figures.

The results of this study indicate that fewer of the patient group are found in the more highly educated category and proportionately more in the lowest category; that in the professional and white collar groups the illness is found to a somewhat lesser extent, and to a greater extent in the craftsmen category; and that the incidence of chronic alcoholism as well as total inebriates is higher in the patient group. These results may well indicate that the incidence of the clinical picture may be influenced by factors in life history. These factors, in turn, may represent symbols of poorer personality integration and thus lessened equipment with which to meet the challenge of a growing impairment.

F

The Effect of the Inhalation of 5 Per Cent CO_2 and Hyperventilation on Cerebral Vascular Tone of Elderly Patients.

J. F. FAZEKAS *and* A. N. BESSMAN, *Gallinger Municipal Hospital, 19th St. and Massachusetts Ave., Washington, D. C.*

Cerebral blood flow, vascular resistance, and metabolism were measured in elderly patients (over 50 years of age) with cerebral arteriosclerosis with or without hypertensive vascular disease. In the majority of patients, the inhalation of 5 per cent CO_2 resulted in an increase in cerebral blood flow and a decrease in cerebral vascular resistance. The changes were not as marked, however, as those observed in younger patients without cerebral vascular disease.

Although hypertension was present in some cases, the inhalation of 5 per cent CO_2 was nevertheless followed by a significant increase in cerebral blood flow and a significant decrease in cerebral vascular resistance. A relatively small number of patients showed no change in cerebral hemodynamics following the inhalation of 5 per cent CO_2. Voluntary hyperventilation caused a decrease in cerebral blood flow and an increase in cerebral vascular resistance in the presence of cerebral vascular disease with or without hypertension in the elderly group of patients. Similar changes were noted following intravenous administration of aminophylline to a comparable group of patients.

In the patients studied, neither hyperventilation, aminophylline, nor the inhalation of 5 per cent CO_2 altered the cerebral metabolic rate. These results indicate that the cerebral vessels of most elderly patients are capable of considerable fluctuation in vascular tone despite the presence of cerebral vascular disease.

Rorschach Findings as Correlated with Physiologic Changes of the Aging Process.

L. L. FROST, M. B. THALER, E. W. BUSSE, *and* M. SHY, *Division of Psychosomatic Medicine, University of Colorado Medical Center, Denver, Colorado.*

Approximately 200 patients, 60 years of age or older, were examined with a battery of psychologic tests, including the Rorschach, partial Wechsler-Bellevue, Weigl Color-Form Sorting Test, and Figure Eights Test. Half of the patients were attending the out-patient department of the University of Colorado Medical Center and, meeting certain criteria, volunteered their participation in this investigation. Some were volunteers from other sources. The remaining half of the patients were in the Colorado Psychopathic Hospital for observation prior to disposition. Completing the investigation, each patient received a thorough physical, neurologic, and laboratory examination, an electroencephalogram, and critical flicker fusion test. Medical and social histories were secured and a mental status examination was made.

The age range of the patients was from 60 to 101 years, the mean age being 74 years. The sex distribution was approximately equal.

After determining that the sample was within psychologic limits for an anticipated normal group for this age range, the Rorschach protocols were evaluated from the standpoint of describing certain formal characteristics about the personalities of the group, and attention then given to individual personality constellations within the group. Evaluation was made of the actual content of the records to ascertain further contributions at this level.

The features found in this evaluation were correlated with pertinent observations from the physical, neurologic, laboratory, electroencephalographic, critical flicker fusion tests, and work-ups, and tentative hypotheses regarding the physiologic and psychologic aspects of aging were made.

This investigation was supported by a research grant from the National Institute of Mental Health, National Institutes of Health, Public Health Service.

G

Clinical and Pathologic Characteristics of Coronary Heart Disease in the Aged.

I. Gerber, S. Storch, *and* F. D. Zeman, *The Home for Aged and Infirm Hebrews, New York, New York.*

Over the past nine years particular attention has been paid to the clinical and pathologic picture of coronary heart disease in aged individuals, with reference to points of differentiation from the manifestations of this disease in young individuals. The average age of our series is 80 years. Emphasis is laid upon the atypical symptomatology, the diagnostic difficulties, the high incidence of complications, the frequent occurrence of arrhythmias, and the remarkable ability of the injured myocardium to recover from serious injury.

An interesting feature of this series is the high incidence of cardiac rupture which has already been described in a separate communication. Of unusual interest is the effect of the patient's mental status on the symptomatology.

We believe that diagnosis of coronary heart disease in older individuals is associated with many difficulties which may be overcome in time through closer clinical and pathologic correlations.

The Serum Lipid Pattern in Old Age.

M. M. Gertler *and* B. S. Oppenheimer, *Medical Department, Home for Aged and Infirm Hebrews, New York, New York.*

A study was made of 38 men and 91 women past the age of 65 who had not experienced a myocardial infarct prior to this study.

Venous blood was drawn prior to breakfast and the serum separated within four hours. Analyses were made of the following substances: cholesterol (free, esterified, and total), lipic phosphorus, total lipids, neutral fats, S_f 10-20 molecules, and ratios thereof.

The women as a group showed higher serum lipid values than the men in all lipids except the neutral fats. It is impressive that the ratio of total cholesterol to lipid phosphorus was equal in both the men and women.

The significance of these findings will be discussed in reference to the role of lipids in the genesis of atherosclerosis in both men and women advanced in years.

(This investigation was made possible by the Louis K. Anspacher Foundation.)

The Older Worker as a Marginal Person in Contemporary Society.

E. Ginzberg, *Conservation of Human Resources, Graduate School of Business, Columbia University, New York, New York.*

The Conservation of Human Resources Project at Columbia University has been engaged in basic research in the field of work during the past three years. Focused on the adjustment problems of the lower marginals (the handicapped) and the upper marginals (talented persons), the several studies are being carried on against a background of the changing role of work in American society, 1890-1950. Selected findings from these several investigations will be drawn upon to contribute to an understanding of the older worker as a marginal person in contemporary society.

Life Span in Man and Vital Statistics.

R. Ginzberg *and* V. Olsvary, *Gerontological Unit, Mental Health Institute, Cherokee, Iowa.*

A stumbling block in the determination of life span in man is the fact that hardly any physiologic deaths have been observed so far. The overwhelming majority of elderly die from diseases and injuries and therefore die pathologically and not from old age or old age alone.

As long as people continue to die from pathologic causes, the only correct answer to the question of life span is that it is yet to be determined. The definition that life span in man is the highest age ever reached by any individual is unsatisfactory. A long-lived person could be an exception and/or a victim of diseases in spite of the late age which he reached.

It has been questioned whether pure physiologic death is possible. Even so, it cannot be denied that pathologic causes of death vary from one epoch to another and that the upper limit of age predetermined for our species has quite apparently never been reached by a majority or even by a considerable minority of individuals.

Vital statistics open a way for comparative investigations, on a mass scale, of variations in death figures in geographic regions and in different population groups. Changes in causes of death with time furnish some opportunities for studying length of life independently of present pathologic causes of death.

This study is based on an analysis of vital statistics data for 1948. Their value in determination of life span has been investigated. It is concluded that the West North Central states offer the best opportunities for studies of the upper limits of life reached by large population groups.

Recommendations for Psychiatric Care in a Home for the Aged.

A. I. GOLDFARB, *The Home for Aged and Infirm Hebrews, New York, New York.*

A two year investigative-treatment program in a modern home for the aged has demonstrated the usefulness of psychiatric facilities in the screening of applicants, the management and disposition of patients, the education of personnel, and the active psychotherapy of emotional disorders. The availability of psychiatric assistance has probably decreased the number of transfers to mental hospitals and has definitely saved the time of internists and other specialists, thus freeing them for their specific work.

A brief therapy technique has been developed on the basis of 75 cases which promises to be effective in the active therapy of aged persons. The study indicates there is need for a part time psychiatrist in the Home, that brief, effective psychotherapy of aged patients can be developed, and that personnel benefit from psychiatric education.

Psychotherapy in the Aged. II. Utilization and Effectiveness of "Brief" Therapy.

A. I. GOLDFARB, *The Home for Aged and Infirm Hebrews, New York, New York.*

Emotionally ill aged are increasing in number as the life span lengthens. In all aged persons the benefit of psychiatric investment is limited by their few remaining years and the paucity of remaining physical and mental resources. This invites the conservation of psychiatric facilities without denial of reasonable care. There is thus need for investigation to develop effective brief techniques of psychotherapy of the aged.

On the basis of examination of over 150 aged persons and treatment of about 75 of these, a method of brief, spaced, short term psychotherapy has been crystallizing. This treatment is based on a theoretic schema which considers the loss of resources in the aged as a most important basis for the arousal of feelings of helplessness. The ensuing anxiety the person then tries to overcome according to the mechanisms established in the past by reorganization of behavior along lines of fearful or angry dependency. This constitutes a search by the patient for a supportive parental figure which can be effectively utilized by the therapist. As a potent authority elected by the patient's own need he is in a position to decrease the patient's fear and rage by appropriate management of the relationship. Increased adaptive capacity results, with consequent decrease of feelings of failure and increase in pride. Fuller utilization of the remaining resources follows and a more stable, healthier adaptation is the result.

Changes in Adrenal Cortical Function During Aging in Rats.

B. GRAD, O. SHER, *and* S. SYMCHOWICZ, *Department of Psychiatry, Allan Memorial Institute, McGill University, Montreal, Canada.*

Changes in adrenal cortical function during aging were measured in 110 male rats selected as follows: (a) young rats averaging 7 weeks of age; (b) middle-aged rats averaging 8 months, and (c) older aged rats averaging 19 months.

Four different substances were administered: one series of rats of the above three ages received nembutal only, a second group received nembutal and cortisone acetate, a third group received nembutal and ACTH, while the fourth group received nembutal and epinephrine hydrochloride. The substances were administered in a single injection intraperitoneally. The number of circulating eosinophils was determined in samples of tail blood collected at 0, 1, 3, and 4 hours after treatment. The percentage fall in circulating eosinophils three and four hours after treatment as compared with the initial counts was considered a measure of the degree of stimulation of the adrenal cortex.

There was no statistically significant age difference in response to the nembutal, cortisone acetate, or epinephrine hydrochloride treatments. Nor was there any reliable difference in the eosinopenic response to ACTH between young and old, or middle-aged and old rats. However, there was some indication that the young rats had a greater fall in circulating eosinophils after ACTH than did the middle-aged rats.

In another series of experiments on rats at the three age levels, eosinophil counts were determined once daily for several days before and after adrenalectomy. In these experiments the youngest group of animals showed the greatest rise while the oldest showed the least rise after adrenalectomy.

(This work was supported by a grant from the Federal-Provincial Mental Health Grants).

H

Company Practices Regarding Older Workers and Retirement.

EDWIN SHIELDS HEWITT *and* ASSOCIATES, STAFF, *Libertyville, Illinois.*

The report describes and discusses the results of a

questionnaire sent to 657 companies with respect to the following areas of activity: (1) the retention of older workers, (2) the preparation of workers for retirement, (3) contacts with and policies toward workers after their retirement, (4) company retirement benefit plans, and (5) rehiring retired workers.

An important barrier to the retention of older workers seems to lie in the area of objective methods of job placement such as job analysis and medical evidence adapted for the special case of the older person. Practices which seek this objective are investigated in the study. The role of the union contract, changes in the worker's compensation, and other subjects relevant to the assignment of older workers to lighter work are also investigated.

Most of the companies attempt in some way to help the worker in preparing for retirement. More than half of the companies use pre-retirement counseling programs; less than 10 per cent, however, have counseling programs which have a minimum of two interviews extended over a period of one year. Some companies increase the time off the job for the employee as he approaches the retirement age.

A wide variety of ways of contacting retired workers are investigated. Many types of mail contact are used, and many companies encourage retired workers to take an active part in employee social and recreational programs, frequently at a reduction in cost. The extent to which coverage under company life and health insurance programs is extended to retired workers is also presented.

Retirement programs are treated in detail; the frequency of compulsory and automatic provisions is noted. Almost half of the employees are subject to compulsory retirement. The method used to determine the retirement date under flexible plans is described. Under flexible plans, 68 per cent of the workers becoming eligible to retire (at age 65) are still at work one year later. In some companies 50 per cent are still at work five years later.

The practice of rehiring retired workers during labor shortages and rush seasons is shown. Some companies have studied the factors which influence those workers who choose to remain at work after becoming eligible to retire.

Tabulations were made showing how the size of the company and the industry in which it is engaged affect its retirement policies. The entire study is primarily oriented toward practices which in some way are relevant to the continuation of older persons in some form of productive employment.

J

Differences in the Job Satisfaction of Urban Teachers as Related to Age.

G. H. JOHNSON, *American Institute for Research, Pittsburgh, Pennsylvania.*

The problem of this study is to determine age differences in job satisfaction and to evaluate characteristics of the job associated with age differences. The subjects were 1086 teachers from urban communities of over 10,000 and under 100,000 population in Central New York, ranging in age from 20 to 69.

Questionnaire data were analyzed concerning differences between decade-age groups (sex and marital status constant). Data included self-evaluations of job satisfaction, ratings of job characteristics as to their importance to satisfaction, responses to 123 questions concerning the job (from which a job satisfaction score was derived) and free-response reasons for satisfaction and/or dissatisfaction.

Job satisfaction increased significantly with age, the relationship being non-linear, with cycles of decreased satisfaction characteristic of certain age-sex-martial status groups.

Individual items which revealed significant increments in satisfaction with age related increased satisfaction to (1) a settling down tendency (no wish for change, acceptance of the status quo and of job limitations, habituation to work), (2) increased interest in and liking for teaching and a greater dependence on it as a source of satisfaction, (3) better interpersonal relationships with employer and associates, and (4) feelings of greater competence and security.

Certain items revealed dissatisfaction among older females with respect to the work load as being excessively fatiguing and demanding, being discriminated against, and inadequacy of income, security, and future possibilities. Goal-striving behavior and expectancies of advancement and progress declined with age. Ratings indicated that all ages attached essentially equivalent importance to the various job characteristics rated, except for attributes concerned with security, status, settling down, and physical exertion and fatigue. Greater importance was attached to those characteristics lacking or deficient in the actual job situation.

Some Early Circulatory Changes Associated with Aging.

H. B. JONES, *University of California, Berkeley, California.*

The exchange rate of simple substances in peripheral body tissues is depressed progressively throughout adult life. These changes associated with age have been observed in men by measurement of inert gas exchange, measurement of tolerance to decompression sickness, measurement of the respiration recovery rate from mild exercise, and measurement of distribution rate of radioactive sodium.

It is believed that the rate of perfusion of blood through the muscle tissues of the body has been de-

pressed with age and is the common associated cause of these changes. In 18 year old men the average perfusion of the resting musculature is estimated to be 25 ml. of blood per liter of tissue per minute; this falls in the 25 year old male to 15 ml/liter/minute and by 30 to 35 years the perfusion rate has dropped to 10 ml/liter/minute.

These changes may be of great individual variation and there is every reason to believe that the depression of blood perfusion continues to progress throughout the life of the average person. Marked individual differences are apparent, with some improvement in perfusion rate suggested by physical conditioning. It is possible that the reduction in the nourishing perfusion of blood through these carcass tissues induces some of the changes that are finally associated with aging.

It is estimated that body tissues, in order to survive, must have a minimum perfusion of 5 ml. of blood per liter of tissue per minute. This will be approached by the average individual in his 60th to 70th year, but even when the average perfusion rate is highest, there are always some tissue areas at any time that are poorly perfused, and as the average tissue blood perfusion rate decreases there is more and more likelihood that some parts of tissues are being critically deprived of nourishment.

It is quite possible that the depression of blood perfusion of the tissues has come about from a decreased metabolic requirement of aging tissues, rather than that it has imposed, through a restriction of nourishment, a metabolic decline of tissue. In either of these events, the blood perfusion changes suggest their use as measures of physiologic age, and they are occurring from very early adult life over the age span associated with decline of physical vigor.

K

The Changing Perspective of the Public Welfare Agency in Planning for Its Senior Citizens.

J. KAPLAN, *Hennepin County Welfare Board, Minneapolis, Minnesota.*

A description is presented of the two year experiment by a local public welfare agency in pioneering a position unique in the United States, *group work consultant,* in order to implement opportunities for older people to lead more satisfying lives. The findings are based on the results of the leadership exercised by the Hennepin County Welfare Board, Minneapolis, Minnesota, through observation and experience, social group work process recording, and social casework records.

Experience has demonstrated that a public welfare agency is in an advantageous position to promote activities for older people, to coordinate existing community facilities, and to establish new services where the need arises. As a result, opportunities for quantitative and qualitative associations through group life have been enormously increased in the county; the many and specific groupings of the community have become more aware of the phenomena and challenge of aging; industry has increasingly recognized its responsibility in planning with the older adult.

The task of the group work consultant was to meet the needs of older people and to include within the goals of a public welfare agency the additional responsibilities for preventive and rehabilitative social services not necessarily connected with direct economic and medical need as a primary public welfare function. Consequently, concrete planning focused on developing opportunities for emotional security and social usefulness, opportunities to work and earn commensurate with ability to do the job, and opportunities for continuation of creative activities or guidance in the positive use of leisure time were undertaken.

Effectiveness of Mailed Material in Inducing Older Persons to Obtain Chest X-Rays.

O. J. KAPLAN, *San Diego State College, San Diego, California.*

The purpose of the study was to assess the relative effectiveness of four types of mailed material in inducing older persons to seek chest x-rays. The mimeographed sheets used were developed by the Health Education Division of the San Diego Health Department. The mailing list consisted of 2305 men and women over age 65, all recipients of old age assistance.

Half of the respondents received mimeographed material dealing only with tuberculosis; half received sheets discussing both lung cancer and tuberculosis. Personal cards were attached to half of the sheets in each of the two groups. Those receiving the letters were asked to call at the X-Ray Center operated by the San Diego Health Department.

Effectiveness of the campaign was ascertained by checking X-Ray Center records. Subsequent to the mailing of the forms, 164 persons, or 7.1 per cent of the total sample, appeared for x-rays. Of this group, 136 had never been to the Center previously.

Those who obtained material to which a personal card was attached responded almost twice as frequently as those who obtained only a mimeographed sheet. On a percentage basis, more males responded than females. A number of pathologic cases were disclosed in the course of the investigation.

The Use of Metrazol in Arteriosclerotic Patients.

S. KATZENELBOGEN *and* T. C. C. FONG, *St. Elizabeths Hospital, Washington, D. C.*

(Abstract not received at time this issue went to press.)

Histologic Study of the Aging Human Aorta.

D. M. KRAEMER *and* H. MILLER, *Department of Anatomy, State University of New York, State University Medical Center, New York, New York.*

A complete histologic investigation of human aortae of all age groups is in progress. The results are being correlated with a chemical study of the same aortae (Miller and Kraemer). An increase in the albuminoid portion, that is, collagenous fibers, elastic fibers, and reticular fibers with age is evident as shown with Kornhauser's quadruple stain, resorcin fuchsin, orcein, victoria blue, and silver preparations. Ground substance changes are being studied after the tissues have been treated with 0.5 per cent aqueous toluidin blue and periodic acid leucofuchsin.

Prevalence of Diabetes Mellitus Among the Aged. Results of Mass Screening Tests.

C. L. KRAG, *Division of Chronic Disease and Tuberculosis, Public Health Service, Federal Security Agency, Washington, D. C.*

The prevalence of diabetes mellitus is known to be higher among the older population. However, information relative to this has been based upon hospital admissions and mortality data. During the past five years large scale screening of the population for diabetes has occurred, making available information concerning the prevalence among the various age groups in the general population. A review of the literature concerning this subject will be presented and a report given of the results of a survey in one community where 60,000 people were tested.

Pupillographic Study of the Psychosensory Restitution and Aging.

L. S. KUMNICK *and* H. MISIAK, *Department of Psychology, Fordham University, New York, New York.*

The study is an investigation of the possible changes occurring in the psychosensory restitution with age. The extent of psychosensory restitution indicates the effectiveness of psychologic stimulation as shown by the response of the autonomic nervous system. It is important to know whether the process of aging alters autonomic activity as evidenced by pupillary responses. If changes do occur in this phenomenon with age, it may serve as a useful tool in gerontologic studies.

There were 94 white subjects ranging in age from 7.5 to 90.8 years forming 4 age groups. Neurologic and eye examinations were given prior to pupillography.

Pupil was photographed by means of infrared cinephotography as it constricted and dilated in response to light stimulations presented at a constant rate. After 60 stimulations, when the pupil lost its mobility and remained constricted even during the dark phase, a sound stimulation was presented and brought again dilation of pupil, i.e., restitution of response. Pupillograms were made from the films and the pupillary changes were measured.

Significant differences in the responses of the rested, fatigued, and restituted pupil between the young and old group were found. The relationship between age and the size, speed of response, and restitution of the pupil was linear and negative.

Psychosensory restitution occurs in all the age groups; there are significant changes in this phenomenon with age; a shift toward the dominance of the parasympathetic nervous system is indicated.

L

A Study on Serum Lipids in Atherosclerotic and Apparently Healthy Subjects.

T. D. LABECKI, *Heart Disease Control Unit, Mississippi State Board of Health, Jackson, Mississippi.*

The purpose of the investigation was to study, in addition to the chemical approach, the physical makeup of the microscopically visible spectrum of the lipids in human serum. A modification of a previously described dark field technique has been used, resulting in a rather reliable and relatively easy to perform test. In order to gain some insight into other characteristics of the lipid particles suspended in the serum, nephelometry was added later.

The individuals studied were first divided into two large groups: (1) unequivocally atherosclerotic subjects meeting the criterion of proved myocardial infarction and/or angina pectoris; (2) control individuals, the great majority being over 50 years of age and apparently in good health or with only minor noncardiac, nonvascular, and nonhepatic maladies. (The control individuals included residents of Old Ladies Home and Old Mens Home.)

Variations of constancy in the serum chemistry and the chylomicron-lipomicron ratios were thus evaluated, and both atherosclerotic and control cases were placed for a prolonged period of time (from nine to twenty-two weeks and longer) on moderately large doses of lipotropic substances to ascertain the effect, if any, of those agents. While the cholesterol levels, both total and esterified, were apparently not affected by lipotropics in both groups, there was a significant and in some cases very marked lowering in the number of lipid particles .25μ in diameter and larger. This effect was observed without regard to the presence of intimal atherosclerosis, age, sex, or previous levels, which seemed to be surprisingly constant for a given individual.

A survey was made of a comparable number of white and colored individuals in similar age groups with rather similar food habits and living on the same large "model" plantation. The purpose of that survey was to attempt to find out whether any differences exist in certain physical characteristics and chemical fractions of the serum lipids, which differences could be possibly explained by age, sex, or race.

Psychoses and the Physical Rehabilitation of the Aged.

J. B. LAKRITZ *and* H. FENSTERHEIM, *Goldwater Memorial Hospital, Welfare Island, and New York University, New York, New York.*

In the rehabilitation of patients with physical handicaps, psychologic factors play an important role. The problem becomes acute in the aged group because of the relative frequency of psychotic disorders. The purpose of this paper is to demonstrate, through a series of brief case studies, that certain aged psychotics are trainable in physical rehabilitation.

Seven patients, ranging in age from 63 to 80 years, are presented. These patients were selected from the rehabilitation wards of the Goldwater Memorial and New York City Hospitals of the New York City Department of Hospitals.

The psychotics are divided into three categories: 3 patients with organic psychoses, 2 with post-operative psychoses, and 2 with chronic functional psychoses. Behavior and psychologic test findings of each patient are described, along with some specific problems in treatment. Progress in physical rehabilitation training is then evaluated.

All the patients presented were psychotic, yet all benefited from rehabilitation training at least to the point where they were able to return to their homes and minimally care for themselves with some family supervision. It was noted that these patients were treated with very little disruption of rehabilitation ward routine. It is concluded that a psychosis in an aged patient is an obstacle, but not an insurmountable obstacle, in physical rehabilitation.

Age Changes in Living Arteries of Man.

M. LANDOWNE, *National Heart Institute, National Institutes of Health, Bethesda, and Section on Gerontology, Baltimore City Hospitals, Baltimore, Maryland.*

As usually determined, the pulse wave velocity increases with age in the central, and probably in the muscular human arteries. Such observations have been construed as indicating an increase in the elastic modulus of the arterial wall. In general, an increase in wave velocity results from decrease in diameter, or increase in wall thickness, as well as from greater rigidity of structure (increased elastic modulus). While all of these factors may vary with age, they are markedly influenced by blood pressure.

Employing a new technique which permits wave velocity to be repeatedly determined in a single subject over a wide range of ambient inter-arterial pressures, estimates of pulse wave velocity in the intact brachio-radial artery have been made on over 100 subjects aged 12 to 92 years. In any individual, pulse wave velocity increases with pressure and this change is larger than differences in velocity between individuals compared at any selected pressure.

The relationship between wave velocity (v) and pressure (p) undergoes an alteration with age. The slope $\left(\frac{dv}{dp}\right)$ at any presure decreases until the sixth decade and then tends to increase again. An increase in velocity with age is found only within a limited pressure range. Furthermore, clinically detectable local arteriosclerosis (largely medial) was not associated with increased wave velocity. The major change in the relation between velocity and pressure occurs in individuals under 40 years of age. The findings, interpreted in terms of the rubber-like elastic behavior of living tissues and the interrelationships of vessel dimensions, do not yet warrant the simplification that the wall of muscular arteries "stiffens" with age.

The Practice of Non-Resident Care for Elderly People.

R. LAVERTY, *Peabody Home, New York, New York.*

Peabody Home for Aged Women in New York City now has a seven year experience in a home care program for elderly women under casework staff. The increasing numbers of older people in the general population and the lack of sufficient facilities to meet their needs place pressure upon communities to study and develop new services. While there is nothing new in the concept of home care, the increasing responsibility assumed by organizations for coordinated services outside of institutions for the health and welfare of older people is gaining new impetus.

This paper will describe the services involved in the administration of the Non-Resident Aid program of Peabody Home. The various aspects of care will be covered, such as screening and selection of applicants, financial arrangements, health factors, employment, living arrangements, recreation, casework therapy, and the use of community resources for the benefit of the non-residents participating in this program.

Man's Most Creative Years: Summary and Interpretation.

H. C. LEHMAN, *Department of Psychology, Ohio University, Athens, Ohio.*

This paper comprises the final chapter of a forthcoming book which sets forth the ages (1) at which outstanding thinkers have most frequently made their momentous creative contributions, (2) at which leaders have most often attained important positions of leadership, and (3) at which high-salaried workers in several areas have most commonly received large annual incomes. A few data for professional athletes are included to show their similarity to the other findings.

Sixteen possible factors which make for early creativity are listed as promising lines for further research. Five possible contributing factors that cause leadership to occur usually at elderly ages also are listed and discussed briefly.

Possibly every human behavior has its period of prime. No behavior can appear before the groundwork for it has been prepared, but in general it seems that the conditions essential for creativity and originality, which can be displayed in private achievement, come earlier than those social skills which contribute to leadership and eminence and which inevitably must wait, not upon the insight of the leader himself, but upon the insight of society about him.

Differences in the Rate and Trend of Mortality for Different Age Groups in Different Eras.

W. H. LEWIS, JR., *135 East 64th St., New York, New York.*

The outstanding effect of medical science in the past half century has been the tremendous increase in the chances for survival of the individual.

The major potentials for increase in longevity have until recently mostly affected individuals in the first 50 years of life.

This situation is being changed. It has shown a significant alteration in the most recent decennial era (since 1940) for several reasons, especially because of the considerable gain in the treatment of infectious disease by the relatively new chemo- and anti-biotic therapies. The benefits have been greater for the population under 50 years of age; they are now more apparent and measurable for those over 50 years of age.

The benefit to those over 50 are shown more directly by expressing the rate of mortality or survival at different ages for the different decennial and semi-decennial eras from 1890 to 1950 (figures from U. S. Bureau of Census and Life Tables.) The tables and graphs so obtained can be contrasted with the usual procedure of estimating the expectation of life at different ages for these eras. Time or age can be considered as a distinct factor in health and mortality similar to an entity of disease, such as pneumonia or coronary thrombosis. If we select a five year unit of time as such a factor in mortality, we can observe a distinct decrease in the rate of mortality of individuals aged 50 to 75 years in the 1940-1950 decennial era compared with previous eras.

The Human Life Cycle and its Interruptions; a Psychologic Hypothesis.

M. E. LINDEN *and* P. D. COURTNEY, *Norristown State Hospital, Norristown, Pennsylvania, and Institute for Research in Human Relations, Philadelphia, Pennsylvania.*

The concepts of climacterium and involution have been stultifying and restrictive, tending to over-emphasize the importance of youth and sexual fertility, while relegating post-climacteric existence to an ignominious place in the scheme of civilization. The physiologic events of the climacteric not only tend to terminate the reproductive function, but also prepare the individual for subsequent social functioning. Contrary to popular views holding that older people are restricted in interests, study suggests their social outlook is actually broader and less selfish than younger people's.

The human life cycle can be divided into halves. For the first half the term "evolescence" (E) is coined. The second half is called "senescence" (S). The "E's" are rebellious against the "S's" and their tenets. The "E" rebellion is expressed as definance, desire for social change, urge for individual expression, and a search for new truths. The "S" counter-rebellion is witnessed to be a continuous restatement of old ideals, an increased tenacity to the established, reluctance to countenance social revolution, and increasing awareness of the value of the past as a predictor of the future. Plotting age increments against theoretic increments of social orientation, stages of progressive altruistic or protective behavior are found and named, punctuated by three periods of instinct supremacy—infancy, puberty, and physiologic involution. The egocentricity of evolescence diminishes with aging. The question of the inevitability of senility is discussed. Senility-to-death seems psychophysiologically analogous to the period birth-to-puberty in reverse. A graphic presentation of the theory is included. Proposed research to test the hypothesis is outlined.

M

An Electrophoretic Analysis of Serum Proteins in Health and Diseased Subjects at Different Ages.

E. MANZONI, G. MARS, L. RAVIZZA, A. RIVOLTA,

and R. SCARZELLA, *Clinica delle Malattie Nervose e Mentali, University of Turin, Turin, Italy.*

(Abstract not received at time this issue went to press.)

A Clinical Study of the Platelets and of Biochemical Factors Related to the Blood Coagulation in Healthy and Diseased Old Subjects.

E. MANZONI, M. MORPURGO, G. RAVIZZA, A. RIVOLTA, *and* R. SCARZELLA, *Clinica delle Malattie Nervose e Mentali, University of Turin, Turin, Italy.*

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The Ophthalmoangioscopic, Craniologic, and Electroencephalographic Picture in Old Age.

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About 100 normal and diseased subjects aged from 70 to 90 years have been studied in order to search out possible correlations between ophthalmoangioscopic, craniologic, and electroencephalographic pictures in the involutive age. E.E.G. records have been taken by an eight-channel Kaiser machine with master switch through the routine exploration of electrical brain activity by means of unipolar (Gibbs, Lennox, Liberson) and bipolar circular (Walter, Frey) derivations without hyperpnea and during overbreathing.

Critical analysis and classification of the data obtained have been made following Gibbs and Lennox criteria. During the follow-up period subjects to be investigated underwent a complete clinical and biochemical examination: the latter consisted of urinalysis, determinations of N.P.N., glucose and cholesterol blood levels, turbidity and flocculation tests, capillary fragility tests, and electrocardiographic records.

The critical evaluation of the up-to-date findings suggests that correlations between ophthalmoangioscopic, craniologic, and E.E.G. pictures are not as common as generally supposed. Severe retinal changes and deep alterations of the bone structures of the skull may coexist with a normal brain activity and vice versa. More constant, however, seems to be the influence of the blood biochemical changes on the cortical activity. These results warrant further research, considering both the theoretic and practical interest of this comparative study.

Psycho-Physiologic Problems of Aging in Airline Pilots.

R. A. MCFARLAND, *School of Public Health, Harvard University, Boston, Massachusetts.*

Problem: The purpose of the paper is to discuss the implications of aging on safety and efficiency and probable length of service in airline pilots. Civil airmen represent a highly selected and homogeneous group with regard to fitness and ability and there is strong motivation to remain on active duty as long as possible. The primary question is to evaluate the age range within which certain psycho-physiologic reactions can no longer be compensated for by training, experience, and judgment.

Population: In 1950 there were approximately 8,000 airline pilots. Tests were given to approximately 300 of these subjects, 21 to 60 years of age. The age distributions at various intervals over the past ten years were analyzed to show the changes from year to year.

Procedure: Several psycho-physiologic functions were selected for experimental analysis. In testing ability to hear, measurements were made with a standard audiometer. Vision at low illumination was determined with a Hecht visual discriminometer. Complex reaction times were studied with the Mashburn serial reaction time apparatus. Several additional tests were given relating to vision and intelligence. Ability to carry out duties in flight was judged in terms of flight checks and accidents. The data were then grouped by five year intervals and analyzed statistically. The final step was concerned with the analysis of changes in age in relation to design of equipment and medical standards.

Results: The findings indicated that there were significant changes in these psycho-physiologic functions in relation to the age intervals indicated. No relationship was found, however, between age and accidents or between the findings on the tests and failure in flight checks. In general, it was concluded that the changes in the various functions studied were less than frequently supposed. At present it is not known what percentage of the total group will be able to perform their duties after 50 or 60 years of age.

Worker Nostalgia — A Retirement Problem.

W. C. MCKAIN, JR., *Department of Rural Sociology, the University of Connecticut, Storrs, Connecticut.*

One of the bonds frequently severed in the retirement process is the worker's identification with the company with which he has been associated. Five hundred companies employing a minimum of 2500 persons were surveyed in an attempt to discover the kinds of post-retirement contacts that are being afforded retired employees.

The number and variety of opportunities that are offered retired workers suggest (1) that many concerns are aware of the attachment that their employees have to their place of work and to their employer, (2) that considerable ingenuity has been dis-

played in maintaining the morale of retired workers, (3) that there are variations among the different types of industry in the kind of post-retirement contacts made available to their retired employees, and (4) that despite evidences of widespread interest, this field of retirement preparation is still relatively undeveloped.

Case Studies of Well-Adjusted Persons over 70 Years of Age.

J. P. McNULTY, *Ohio State University, Columbus, Ohio.*

This study attempted to assess by nondirective interviews, qualities of older persons selected by their peers as representing fine personality adjustment. The author interviewed each very informally (most several times) as to their feelings about retirement, present activities, interests, and changes in these factors preceding and after retirement.

All were highly cooperative; in general they were above the general population in health for their age. Their feelings about retirement varied from relief to frustration. Activities varied from continuance of their former professional work to complete change. There were wide differences in economic security, which did not seem related to enjoyment of retirement. Most of them had decreased their social contacts drastically, and those that remained were with peers. Participation in religious ceremonies was noticeably missing. Health factors were rated highly as contributing to enjoyment of retirement. The social stereotype of the oldster seems to be grudgingly accepted primarily by those not in competition with others as to economic demands, while those actively engaged in vocational pursuits deny this role.

The method of approach used in this study seems to give data and insights much richer and more intimate than questionnaire studies. Great individual differences are found in this quite homogenous group of old individuals. Personality changes per se do not appear; rather continuation of behavior patterns of long standing is the rule. Continuation in work past 80 was found. Subtle feelings of progressive loss of status, and after retirement of not belonging, were important in several cases. The series of informal interviews, usually at the person's house, seemed especially permissive for such feelings to appear. Sundry suggestions for preparation for retirement and for facilitation of adjustment afterward were obtained.

Aging in Air Force Pilots as Studied by the American Institute for Research.

W. R. MILES, *Department of Psychology, Yale University, New Haven, Connecticut.*

Problem: To discover the effects of aging in relation to on-the-job performance and related attitudes of Air Force aircrew personnel.

Subjects: 850 aircrewmen were interviewed at bases in continental United States, and in Hawaii, Korea, and Japan.

Procedure: The Critical Incident Technique was used to collect reports from aircrew on effects of aging which they had observed in their own performance and the performance of others. A group interview technique was used in which written responses were obtained. Subjects were requested to cite incidents in which effects of aging had a critical effect, either leading to notably poorer or better performance.

Results and Conclusions: The data, when analyzed and classified, indicate that impairment due to age occurs in the following five major areas: (1) physical abilities necessary for effective performance are affected, in particular the ability to resist fatigue and excessive demands upon the organism; (2) ability and motivation to improve in skill and technique tend to decline with age; (3) actual job performance deteriorates particularly with respect to speed and accuracy of work and corrective action, retention of control in emergency situations, and retention of a proportionate degree of caution; (4) there is some indication that relationships with co-workers tend to become poorer; (5) finally, motivation and adjustment with respect to the job are in general negatively affected by age.

Combination of Hydrochloric Acid and Sodium Hydroxide with Human Aortic Albuminoid.

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The albuminoid (collagen and elastin) fractions of 29 human thoracic aortae were prepared by acetone, alcohol, sodium chloride, and sodium dibasic phosphate extractions. A weighted aliquot of each dried sample was allowed to stand for twenty-four hours, with occasional shaking, in dilute hydrochloric acid or dilute sodium hydroxide solution saturated with sodium chloride. The amount of acid or base combined by each specimen was determined by titration of an aliquot of the supernatant solution with sodium hydroxide or hydrochloric acid, respectively.

All samples combined with both sodium hydroxide and hydrochloric acid. The quantity of combined sodium hydroxide per unit weight of tissue remained constant despite differences in age and pathologic condition. An approximately twofold increase in the quantity of combined hydrochloric acid was observed to take place progressively between the ages of 30 and 90 years. Markedly sclerotic aortae combined with larger amounts of acid than did normal or mildly atheromatous samples, while moderately sclerotic tissues yielded intermediate values.

Company Programs of Preparation for Retirement.

E. H. Moore, *Department of Sociology, University of Oregon, Eugene, Oregon.*

This paper presents the types of programs which selected companies employ in preparing their workers for the retirement break and later maturity, the various means of communication, the areas of discussion, the age level at which pre-retirement counselling and communication is most effective, and some of the later follow-up services to retirants.

N

Age Changes in the Maximum Conduction Velocity of Motor Fibers of Human Ulnar Nerves.

A. H. Norris, N. W. Shock *and* I. H. Wagman, *National Heart Institute, National Institutes of Health, the Baltimore City Hospitals, Baltimore, Maryland, and the Jefferson Medical College, Philadelphia, Pennsylvania.*

The maximum conduction velocity of the largest motor fibers of the left ulnar nerves of 175 male staff members, patients, and employees of the Baltimore City Hospitals equally distributed between the ages of 20 and 90 years were estimated on each of two days. Action potentials from the muscles of the hypothenar eminence were elicited by electrical stimulation (square wave of 0.1 msec. duration) of the ulnar nerve at three separate points (wrist, elbow, and 5 cm. below the axilla). These action potentials were recorded by means of a cathode-ray oscillograph. Latencies (time between stimulus artifact and onset of action potential) measured from the photographic records were estimated to the nearest 0.1 msec. Distances between the points stimulated were measured to the nearest 0.1 cm. Conduction velocities were calculated for the upper, lower, and total arm.

Average values decreased progressively from 57.7 ± 2.1 M. per second in the fourth decade to 48.5 ± 1.7 M. per second in the ninth decade. Analysis of variance indicated a clear age effect for lower, upper, and total arm segments and ability to distinguish between individuals only with respect to the total arm measurement. The day to day variation of individuals including measurement error was ± 2.6 M. per second for the total arm. There was no evidence for systematic difference in conduction velocity of upper arm and lower arm. The changes may begin as early as the fourth decade.

O

The Electroencephalogram of Normal Subjects over Age 65.

W. D. Obrist, *Moosehaven Research Laboratory, Orange Park, Florida.*

The nature and extent of age changes in the electroencephalogram during senescence was studied. The subjects were 150 male residents of Moosehaven between the ages of 65 and 95. They were of average physical health for that age. Persons with serious neurologic or psychiatric disorders were not included in the sample.

Routine monopolar and bipolar recordings were made from the major areas of the cortex over each hemisphere. The test also included a three minute period of hyperventilation. An analysis of age trends was made by comparing two groups of 75 individuals each: those over age 80 (80 to 94 years) with those under age 80 (65 to 79 years). Further comparisons were made between these findings and results obtained by other investigators on normal young adult subjects.

When judged by young adult standards, a significantly higher percentage of abnormal electroencephalograms was found in the 80 to 94 year old group than in the group between age 65 and 79. Both of these older groups showed more abnormalities than reported by investigators working with young adults. The most striking age difference is the greater incidence of slow waves in the records of old people. The mean alpha frequency becomes significantly lower with age and there is an increase in delta wave activity. Preliminary findings suggest that cardiovascular disease is an important determinant of the age changes noted. The significance of these findings for the psychology of aging will be discussed.

Psychologic Aspects of a Survey of Elderly People in County Homes in Iowa.

V. Olsvary, *Gerontological Unit, Mental Health Institute, Cherokee, Iowa.*

A survey of attitudes, background, and health of elderly people in county homes with regard to their personal and social adjustment was conducted by the Gerontological Unit of the Mental Health Institute, Cherokee, Iowa. One hundred twenty-six persons between the ages of 65 and 96 were questioned. This paper describes and analyzes the psychologic condition of only the 47 persons classified as normal and the 23 classified as mild mental.

This group of 70, whose mean age was 74.8 years, was predominantly male (54 cases). The overwhelming majority, 67 persons, were living single lives: 41 had never married, and 26 were widowed or divorced, most of them for over fifteen years. More than half of the total group either had no family, never were visited, or heard from relatives less than once a year. About 56 per cent came from low income families.

Loneliness, depression, and outbursts of temper were the most frequently encountered emotional reactions. Friendships among the residents were rare, and 30 of the 70 "just sit and do nothing" in their spare time. Disappointment in life's work, family, or self was not uncommon. Fifty-four named ages under 40 as being the happiest years, while 34 named ages since 60 as being the least happy years of their lives. The majority resented being in the home and wished they were out, but most of them had no plans for the future.

The paper discusses these and other aspects of the psychologic make-up of the elderly county home residents.

A Corporation Examines the Problems of Adjustment in Old Age.

H. S. Onoda *and* C. B. Gallenbeck, *Gary, Indiana.*

An increasing number of employees are reaching the normal retirement age at Inland Steel. This fact, along with national population trends, has caused us to examine future problems which may face the corporation in regard to older workers and retired employees.

The subjects used are older workers and retired employees. For the past two years our Industrial Relations Research Department has been examining the overall problems of adjustment in old age. Our study has been directed towards: (1) obtaining facts about our older workers and retired employees; (2) determining the problem areas of adjustment; (3) determining if and what Inland can do about them; (4) studying how to improve most effectively these problem areas; (5) evaluating the results of any action undertaken.

Older workers and retired employees are being studied as individuals and as parts of three social groups: (1) national or society, (2) local or community, and (3) corporate or work. With this as a basis, the following areas are being examined: (1) physiologic, (2) economic, (3) sociologic, and (4) psychologic. Many of our investigations have been in the nature of a joint research project with other companies, universities, and private research organizations.

One of these studies has been a joint effort with the Later Maturity Laboratory of the University of Chicago. This study has been on the meaning of work. Data will be presented on the meaning of work and its relationship to various aspects of old age by age groups and by levels of occupations. We believe that our broad frame of reference enables a more accurate evaluation of the problems of older workers and retirement.

P

A Study of Polyzoan Organisms in Brains of Young and Old Mentally Ill Patients.

J. W. Papez, *Laboratory for Biological Research, Columbus State Hospital, Division of Mental Hygiene, Columbus, Ohio.*

A study of brain suspensions under dark contrast, oil immersion, phase microscope shows a wealth of living zooid organisms that infest brain cells in young and old psychotic patients. Specimens were obtained from 20 brain operations on young patients, and from 54 fresh autopsies performed on patients over 60 years of age.

Kodachrome slides of illustrations from 16 representative cases will show the different types of zooids broken out of the small colonies in the cytoplasm of nerve cells. Such colonies are composed of small and large cysts, each giving rise to some type of zooid. Smooth filaments arise, become transversely segmented, and several days later each segment becomes a globule and breaks off. Short rods with a bead at free end are common. They also change to globular forms.

Tentacles at end of some filaments form elongated bulb-syringe zooids with a flexible feeler at narrow end. Heavy globular, pulsating forms, and some water vascular tubes occur in what seem to be old colonies. Dark green cysts with needle-like bristles are sparse. Round cysts containing zooids are common. Large statoblasts, about 6 μ in diameter, containing sequestered zooids, and projecting hooks, tendrils or filaments, are characteristic dormant germs seen in old brains. They give rise to colonies.

All the foregoing variants give a clue to composition of a colony. Mucous sacs that exude from broken colonies form a vehicle for attachment and survival of small globular zooids at end of cycle. In many cases this life cycle has been followed for three to six weeks.

Effect of Aging and Malignancy on Serum Protein Pattern in Dogs.

I. A. Parfentjev *and* L. F. Whitney, *Departments of Microbiology and Pathology, Yale University School of Medicine, New Haven, Connecticut.*

The current study of dog sera has stemmed from a similar investigation of the blood proteins of chickens (Parfentjev and Duran-Reynals, 1951) which focused on the effects of maturation and malignancy and emphasized qualitative changes in serum globulin. The recent work has been a quantitative estimation of serum protein patterns throughout the life span of normal dogs and in the presence of neoplastic disease.

A complete fractionation of each serum sample

has been accomplished using a rapid micro-method for protein analysis by turbidity described elsewhere (Parfentjev and Johnson, 1952). Pilot studies affirm the common observation that the development of a normal young animal is registered in the serum by a gradually increasing total globulin fraction.

It should be noted that the level of total globulin (about 2.46) estimated for the grown animals is within the range established by electrophoretic studies (Chanutin and associates, 1946, Gjessing and Chanutin, 1946, Deutsch and Goodloe, 1945).

When these data from 10 normal adult dogs are contrasted with data from 24 dogs bearing malignant tumors, a distinct difference in pattern is noted (2.46 and 3.21 respectively).

Table 1.

Total No.	Age	Total Protein	Total Globulin	Albumin	A/G
2	0-12 hrs.	4.29	0.92	3.37	3.66
9	4-10 wks.	4.70	1.45	3.25	2.24
2	5½ mos.	5.06	1.72	3.34	1.94
1	6 months	5.47	1.76	3.71	2.10
10	3-13 yrs.	6.36	2.46	3.90	1.59

Table 2.

Group	Total No.	Age	Total Protein	Total Globulin	Albumin	A/G
Normal	10	3-13 yrs.	6.36 (4.05-7.38)	2.46 (1.68-3.13)	3.90 (2.37-5.01)	1.59 (1.06-2.10)
Malignancy	24	3-19 yrs.	6.89 (5.24-7.98)	3.21 (1.76-4.82)	3.68 (2.02-5.31)	1.15 (0.50-2.38)

The mean globulin value of the normal group is significantly different from the corresponding mean value found in malignancy with $P < 0.001$. Albumin, however, is quite constant with little difference between the groups and $P > 0.99$. The observed difference between the average A/G of normal sera (1.59) and that of malignancy (1.15) is a reflection of the significant difference in globulin. Although there is some overlap among the individual sera of the samplings described, additional cases and close clinical following might serve to sharpen the limits of each group.

The finding of an augmented globulin in the presence of malignancy has been observed repeatedly in human blood and results with canine sera are in accord with human studies in progress in this laboratory. Dogs are particularly suitable as an adjunct to such research because the presence of neoplasm is reflected in an altered serum protein pattern identical with the human response. Furthermore, canine tumors are spontaneous and can be followed conveniently with repeated bleedings, while the shorter life expectancy permits complete evaluation.

(This investigation was supported in part by grants from the Division of Research Grants and Fellowships of the National Cancer Institute, United States Public Health Service.)

Benefits from Home Medical Service.

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The Home Medical Service began in 1942 by providing medical treatment in the home for 18 cardiac patients too sick to continue with ambulatory care at the Michael Reese Hospital outpatient department (Mandel Clinic). Since that time the Service has expanded to include all types of medical and surgical cases. These patients come from the outpatient clinic or from the Michael Reese Hospital service cases.

Home Medical Service is of great value to the patient. It makes possible continuation of medical treatment for patients too ill to come to the outpatient clinic. It may be of psychologic value for the chronically sick patient, as, for example, in a case of inoperable carcinomatosis. It may make the remaining life of weeks or months more liveable.

Home Medical Service may be of great value to the patient's relatives and friends who may treasure spending the last days at home with the patient.

The Service is of value to the hospital and physician. It releases valuable hospital beds sooner. Discharge from the hospital can be made earlier without interrupting the medical treatment. Patients with coronary insufficiency, almost bedridden and with chronic congestive failure, may need regular injections of a diuretic. It is not necessary nor psychologically advisable—in fact, it may even be considered med-

ically contraindicated for this patient to be confined to a hospital bed, removed from the family and from the familiar way of life, albeit now limited. A prolonged hospital stay, unless indispensable, is a type of enforced retirement with its associated medical and psychologic trauma.

An acute medical emergency as a hypoglycemic reaction in an unstable diabetic may no longer need immediate hospitalization. Emergency treatment often may be handled adequately at home.

Home Medical Service is controlled by clinic physicians under the supervision of the Chief of the Clinic. These physicians give a complete physical examination and treatment, together with further medical consultation where indicated. It also offers the auxillary services when necessary. These include complete laboratory examinations, ECG, nutrition consultation, and cooperation of the clinic social work staff.

The Aging Syndrome.

R. M. PERLMAN, *Institute of Endocrinology and Gerontology, San Francisco, California.*

The thesis is developed that aging is merely the resultant manifestation of intrinsic and extrinsic environmental factors, stresses, and influences on the living organisms and/or its component related physiologic and organic units. This concept leads to the conclusion that so-called normal aging is, in reality, the composite superficial expression(s) of multiple underlying chronic and/or acute degenerative processes. Consequently, the term normal is a misnomer; by definition, disease is pathologic and cannot be normal.

The rejection of current popular notions in gerontology, viz, that aging phenomena are normal, is vital to the inauguration and propagation of dynamic, effective—as compared to static, passive, and emasculatory—approaches to prophylaxis and therapeutics in aging. The ultimate theoretic aim in gerontology is to realize this ideal of perfection—the restoration and maintenance of the entire animal economy at its full peak of youthful, structural, and functional vigor. Further definition, elaboration, development, and emphasis of the tenet that aging is a syndrome constituted by a composite of chronic degenerative disease processes—the result of environmental impact on organismal potential—will greatly stimulate rapid progress towards the realization of this goal.

Bromsulfalein Sodium Evaluation of Hepatic Function in the Geriatric Patient.

J. POMERANZE, J. I. MIGDEN, *and* B. DUBOVSKY, *Hospital of the Home of the Sons and Daughters of Israel, New York, New York.*

Advancing years bring with them diminished powers of mastication, digestion, absorption, and assimilation. Nutritional problems of the geriatric patient have long been recognized. The effect of this nutritional inadequacy on liver function is important and is the subject of the present investigation.

In attempting to clarify this problem of liver function, 50 ambulatory geriatric subjects varying from 60 to 100 years of age were studied by the bromsulfalein sodium retention method using 5 mg. per kilogram of body weight. Complete clinical and laboratory evaluation of each patient was carefully made.

There was a significantly large incidence of liver dysfunction as evidenced by increased bromsulfalein retention in this series of ambulatory geriatric patients.

An evaluation of the relationship of liver dysfunction to complications such as gall bladder disease, cardiac decompensation, and diabetes mellitus is presented.

It would seem from this study that liver dysfunction secondary to nutritional disturbance is of prime importance in the geriatric patients.

The results of massive "liver therapy" in these subjects will be presented.

R

The Diagnosis of Spontaneous and Induced Tumors in Various Age Groups of Guinea Pigs.

J. B. ROGERS, *Department of Anatomy, University of Louisville School of Medicine, Louisville, Kentucky.*

Spontaneous tumors have been observed in guinea pigs in a colony which has been inbred since 1941. The tumors have been found only in two families; by definition, a family consists of the descendants of a female ancestor.

The colony has been divided into four age groups; (1) 1-365 days (young), (2) 366-730 days (mature), (3) 731-1095 days (old), and (4) 1096-2500 days (senile).

Methods of diagnosis of tumors in living animals have been inspection, palpation, and x-ray. Adenomas of the mammary gland and fibrolipomas of the skin can be seen and felt without difficulty. These tumors have not been found in young animals.

Palpable masses in the peritoneal cavity of males have been leiomyomas attached to the greater curvature of the stomach. They have been found in senile animals.

Palpable masses in the peritoneal cavity of females have been partially resorbed fetuses, myxosarcoma of the uterus, and ovarian cysts. X-ray has been used to rule out a unilateral pregnancy.

Ovarian cysts have been found in mature and older females. The diagnosis of tumors after injection of methylcholanthrene in sesame oil into the sub-cutaneous connective tissue of the ventral abdominal wall of guinea pigs depends first on palpation, later on inspection. The growth of subcutaneous tumors has been recorded photographically.

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Starvation and Longevity of Populations in Tokophrya Infusionum.

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In previous work it was found that a meager diet and intermittent starvation favor longevity in individuals of Tokophrya infusionum, while overfeeding shortens life drastically. It was therefore of interest to find out how a meager diet, overfeeding, intermittent starvation, and long periods of starvation will affect whole populations.

Vitality of populations is manifest first of all in the reproduction rate. Since overfeeding greatly lowers reproduction, and complete starvation applied for some days stops reproduction entirely, it was expected that populations kept on a heavy diet or starved for long periods would die out shortly. That was found to be true as to overfed populations, whose longevity was in many cases limited to only several days.

Surprising results were obtained with populations kept on long periods of hunger in which food was introduced once every week or once every two weeks. Such populations were nevertheless able to survive and reproduce at least for many months and give rise to very vigorous and thriving cultures. This seems to be even more surprising in view of the fact that the life span of Tokophrya lasts only a few weeks.

It might be that during long periods of starvation all the weak individuals are dying out and only the strongest are left. In the next generations a strain is formed resistant to prolonged hunger. This would mean that hunger acts as a selective factor. It might be also that individuals kept without food for long periods are retarded in their development and therefore subject to very slow physiologic aging. Such individuals are, or might be, physiologically young in spite of the lapse of time. This would mean that such starved populations are composed in the majority of physiologically young organisms who are carrying on reproduction, giving rise to the next generation.

A Comprehensive Plan for Gerontologic Evaluation and Rehabilitation.

H. A. RUSK *and* M. M. DACSO, *New York University College of Medicine, New York, New York.*

Despite the fact that chronic disease and disability resulting from an aging population is currently the nation's number one medical problem, there has been little or no coordinated research in the psycho-social-economic aspects of chronic disability and the aging process. During the past decade, medicine has devoted considerable effort to such important pathologic problems as the effects of aging upon the cell, but little of significance has been done to determine how the sum total of these cells—man himself—can best meet the medical, psychologic, social, and economic problems of aging. Research from "man and his environment" down is as important as research from the "cell" up.

While it is true that many of the answers have not yet been found and that the search for the still undiscovered etiology of aging and specific treatment of its causes and disabilities must continue to be a vital element, the time has come to apply the many tools which have been developed and to test the findings of those observations which have been made. This can be accomplished only by exploring the potentials of a cross-section of the aging population by the establishment of a total program applying all of the knowledge presently developed in the field of gerontology, including prevention, definitive therapy, and rehabilitation including the psycho-social-economic factors designed to evaluate and, by a planned program, adequately meet the problems of the aged.

S

An Experiment with Oldsters.

A. SALAMONE, *Adult Education, St. Louis University, St. Louis, Missouri.*

Living in the Later Years is the title of a course that is being conducted at St. Louis University through the Adult Education Center.

Because it is of utmost importance that the older person be informed and helped to understand the newer social issues and community problems, I believe education is one of the important answers to the double question, What can we do for the increasing number of elderly people—and what can they do for themselves? Education will help enrich the lives of millions who otherwise would be left helplessly rocking their way into senility.

If people are taught to make adjustments, the process of aging is far from being a dark and futile marking of time, but rather a fruitful extension of individual living with minimum economic worry.

Oldsters who attend these classes refuse to be shoved aside. They have no intention of rocking hopelessly on a front porch waiting for the undertaker to come.

Friendships and activity keep the aged in good mental health. Happy people are well people. There is a definite need for broad fun and activity programs, much like the Youth Centers, but run at a slower pace.

Educational experience combined with social and recreational activities provides knowledge and practice in the art of mature living.

1. It is possible to be old and healthy, if people are taught to reach later years at their best of health, not their worst.
2. It is possible to keep older workers on their jobs as long as they are able, if personnel men are taught to realize that medical science has outstripped personnel policies.
3. It is possible to have All Day Centers, Golden-Age Clubs, Senior Canteens, broad fun and activity programs for oldsters, if city, state, and federal officials can be made to realize that it is their duty to the community they serve to help organize these programs.
4. It is possible for oldsters who must retire to retire and be happy, if industrial plants would organize retirement programs that would make employees plan ahead for comfort and serenity in their later years.

What is definitely needed is a systematic total program. If the needs for the aged are left unmet, we may look forward to oldsters becoming a bitter, anti-social group—discontented, ready to fight; they may be easy picking for the men who make false promises and endanger democracy.

The Importance of Common Ear Symptoms, Hearing Loss, Tinnitus, and Vertigo, as Early Indications of Beginning Geriatric Changes in Man.

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Hearing impairment is accepted as a common stigma of advancing years, not only by the physician but by his patients. The age-conscious patient may not infrequently even attempt to conceal a hearing loss. The patient consults the otologist because of tinnitus, fullness of the ears, or dizziness, but fails to complain of hearing impairment. Examination most frequently does not show evidence of middle ear abnormality, but audiometric tests reveal a significant perceptive, or nerve type hearing loss. In the past this has been considered an almost natural evidence of the aging process and of little significance as an indication of disease. Therapeutic management of these cases has been limited to the suggestion of a hearing aid for those with loss of servicable hearing.

Why is hearing impairment and other otologic symptoms of labyrinthine dysfunction common and early clinical indications of the aging process? In recent years certain otologic investigators, Hilger, the Fowlers, and others, have stressed vascular dysfunction, with resulting labyrinthine ischemia, as the basic common physiopathologic change in acute and chronic labyrinthine or inner ear disease.

The delicate, highly differentiated neural histologic structures of the labyrinth have a meager endarterial blood supply without the anatomic potentialities of collateral circulation. Therefore the phenomena of blood sludging, vascular spasm, anemia, hypotensions, and other factors producing vascular insufficiency will frequently induce early clinical symptoms of labyrinthine dysfunction. The limited vascularization of the labyrinth provides the basic reason that symptoms of labyrinthine dysfunction caused by vascular insufficiency will occur earlier and more frequently than in other systems and organs with the possible exception of the eye.

A little loss of hearing, unsteadiness, or ringing in the ear should not be considered a natural and unavoidable symptom of aging but an indication for careful examination of the patient for evidence of dysfunction. This anatomic-physiologic concept of vascular dysfunction with labyrinthine ischemia has borne fruit therapeutically, particularly in acute labyrinthine disease, if therapy is instituted before irreversible damage from ischemia to the delicate labyrinthine structures is allowed to occur.

Cases of sudden onset of deafness, tinnitus, or Ménière's symptoms given intravenous vasodilating therapy with, for example, nicotinic acid and neural vascular block with intravenous procaine, have been successfully treated in a sufficient number of cases so that this form of therapy should be considered a medical emergency. The much more common insidious progressive cases of labyrinthine dysfunction also demand careful evaluation of the patient for evidence of vascular dysfunction and aggressive medical therapy to correct, as far as possible, this dysfunction.

If careful examination and supportive therapy is instituted, it is to be expected that at least the future progress of degenerative changes in the labyrinth and other structures of the body will be inhibited or perhaps arrested.

Changes in the Age Structure of the American Population, 1900 to 1950.

H. D. SHELDON, *Population and Housing Division, United States Bureau of the Census, Washington, D. C.*

A description, with particular reference to the upper

age levels, of the trends in the age structure of the population of the United States which have taken place in the first half of the twentieth century, an examination of the demographic factors—natality, mortality, and migration—involved in these changes, and a consideration of probable future trends in age composition will be presented.

Basal Oxygen Consumption and Basal Respiratory Functions in Aged Males.

N. W. SHOCK *and* M. J. YIENGST, *National Heart Institute, National Institutes of Health, Bethesda, and the Section on Gerontology, Baltimore City Hospitals, Baltimore, Maryland.*

Estimations of oxygen consumption, carbon dioxide elimination, total respiratory volume, and tidal volume were made under basal conditions by the Tissot open circuit method in 154 male subjects between the ages of 40 and 90 years. The subjects were ambulatory males admitted to the Infirmary Division of the Baltimore City Hospitals (Old People's Home) for custodial care. After preliminary trials given the preceeding afternoon, tests, consisting of 3 six minute gas collection periods were run on two successive days on each subject. Analyses for CO_2 and O_2 were made on each sample of expired air by the Haldane technique. Analysis of variance of the observations permit the following conclusions: (a) with increasing age there is a significant reduction in basal heat production (from 35.7 ± 0.76 cal/sq.m/hr. at age 40-49 to 30.0 ± 1.0 cal/sq.m/hr. at ages 80-90), (b) with increasing age there is a significant drop in pCO_2 and rise in pO_2 of expired air, (c) there is no significant change in total respiration volume before or after correction for surface area in subjects under basal conditions, (d) day to day variations in all measurements except total respiratory volumes corrected to surface area are significantly greater ($p < 0.001$) than errors of measurement (period to period variation), and (e) individual differences can be measured in all variables.

Mortality Data in the Rat as Related to Age.

H. S. SIMMS, B. N. BERG *and* J. LESTER, *Columbia University, College of Physicians and Surgeons, New York, New York.*

Autopsy findings in our colony of old rats have shown that in rats, as in humans, the number of contributing lesions (primary and secondary) required to produce death (or a moribund state) seem to be independent of age, whereas the number of non-contributing lesions increases markedly with age of the animal.

The data indicate that the increasing death rate with advancing age cannot be accounted for merely by the random accumulation of the independent lesions (with their resulting secondary lesions),—but that an age factor also plays a role. The nature of this age factor is unknown.

Furthermore, in rats, as in humans, the mortality from each adult disease group increases with advancing age according to the equation:

$$\log P_t - \log P_o = kt$$

where P_t is the probability of death at age t, and P_o is the (extrapolated) probability of death from the disease group at the time of birth.

The short life span of rats, as compared with the human life span, is the result of two circumstances. First the intrinsic death rate at birth from the adult diseases (P_o) is much higher than for humans. This presumably has nothing to do with the process of aging. It is true of infectious diseases, of C.V.R. diseases, and of neoplasms—even though the specific diseases within these groups differ between the two species.

Second, the rate of increase (k) in mortality with advancing age is much faster in rats than in humans. If we consider the value of k to be a measure of the aging process, then it corresponds with a faster rate of aging in rats than in humans. However, it is not possible to make a numerical comparison on this basis since the relative values of k depend upon the disease group.

Effect of Moderate Exercise on the Electrocardiogram in Healthy Young and Middle-Aged Men.

E. SIMONSON, *Laboratory of Physiological Hygiene, School of Public Health, University of Minnesota, Minneapolis, Minnesota.*

The effect of exercise on the electrocardiogram was studied in 29 healthy young men (age 20 to 27 years) and in 68 healthy middle-aged men (age 49 to 59 years). Three standard leads and 6 chest leads (V_1 to V_6) were taken at rest (basal conditions) and 3 standard and 2 chest leads (V_1 and V_5) were taken at one and three minutes after walking at 3 miles per hour and on a 5 per cent grade for 15 minutes. Thirty-five E.C.G. items were measured and examined for the effects of age.

The increase of the heart rate after exercise was, on the average, larger in the older men, although there was, as in all items, a good deal of overlapping. The ST depression tended to be more pronounced in the older men, and this was true especially for lead V_5 which faces the epicardial surface of the left ventricle. This latter suggests that exercise produces a greater degree of sub-endocardial ischemia

in the older men. This interpretation is consistent with the findings at autopsy of atherosclerosis of coronary vessels in a large proportion of the older population and with the decrease of cardiac work capacity with age.

The decrease of the R wave in lead I was, on the average, more pronounced in older men. Both groups showed a significant post-exercise right axis shift of the QRS and of the T axis, a decrease of the T wave in V_5 and an increase of the S wave in the same lead.

The Efficiency of Older Workers in Various Types of Jobs.

M. W. SMITH, *Ohio State University, Columbus, Ohio.*

The material reports a portion of an extended research program with regard to the potentialities of older persons for gainful employment. Study was made of about 5,000 male and female workers in a large industrial installation, ranging in age from under 20 to over 70. The attempt was to relate evaluations of these workers by their supervisors to age, within specific job categories. Results indicate that trends with age in efficiency do vary somewhat with the job under consideration. For instance, in work emphasizing job knowledge, judgment, skill, and craftsmanship, rather than speed and physical endurance, the older worker compares favorably with the younger and middle-aged.

Further, the specific characteristics in which the older workers excell or are excelled by their younger counterparts (e.g., general efficiency, attitude, congeniality, job knowledge, steadiness, etc.) depend much upon the type of job. Such findings presumably result from variations in selection procedures as well as from actual changes with age. In any event, they offer many clues as to ways in which industry and research can contribute both to better placement of older workers and to better adaptations of the job and the working environment to their potentialities.

Liver Function in the Aged.

H. SORTER, *Drexel Home, Chicago, Illinois.*

There is no clinical evidence of disturbed liver function in the aged. Yet, a number of liver function tests indicate various deviations from the normal averages. Also a greater incidence of increased sedimentation rates is observed in aged subjects. These findings may be related to nutritional deficiencies or gastro-intestinal changes in digestion and absorption. The study was performed on residents of the Drexel Home for the aged.

The Evaluation of the Cornell Medical Index in the Study of Elderly Individuals.

R. STEINHARDT, F. D. ZEMAN, J. TUCKMAN, *and* I. LORGE, *Home for Aged and Infirm Hebrews, New York, and Teachers College, Columbia University, New York, New York.*

The increasing use of the Cornell Medical Index in the study of elderly individuals has suggested that the validity of the conclusions be tested against the actual medical records of institutionalized old people. This has been carried out by a team of physicians and psychologists, utilizing the medical records of the Home for Aged and Infirm Hebrews, which are characterized by attention to the pathologic lesions found on examination and by the effort to make an estimate of the over-all functional capacity of each person examined.

Studies carried out in this way on 72 men and 99 women, average age 75.9 years, indicate that there is close correspondence between the Cornell Medical Index findings and the functional capacity ratings arrived at by careful medical evaluation.

Of particular interest is the finding that women report more somatic and psychosomatic complaints than men. This is due, we believe, to cultural factors rather than to actual health differences.

In general, the Cornell Medical Index is believed to be a useful tool in approximating the health status of large groups of old people.

Cardiac Arrhythmias in the Aged.

S. STORCH *and* Z. T. TANG, *The Home for Aged and Infirm Hebrews, New York, New York.*

The object of this study is to describe the types of cardiac arrhythmia present in a large cross section of the patients in this institution for the aged, with particular reference to clinical behavior, associated diseases, and response to therapy.

Approximately 1000 consecutive electrocardiograms of over 500 patients in a fifteen month period have been analyzed and correlated with clinical records and autopsy findings.

The utility of newer drugs in therapy is estimated, with particular reference to Pronestyl, Cedilanid, and Neosynephrine. The effects of morphine, Prostigmine, Mecholyl, Urecholine, quinidine, strophanthin, digitalis, and carotid sinus stimulation were especially considered.

The various arrhythmias are tabulated in order of their frequency, and their prognostic significance is emphasized.

T

Pressure Effect of Aging on Reported Work Performance.

J. TUCKMAN *and* I. LORGE, *Teachers College, Columbia University, New York, New York.*

The purpose of this study is to investigate the effect of aging on reported work performance. A representative sample of retired union members in one division of a major industry in New York City comprised 240 industrial workers (216 men and 24 women), 65 to 85 years of age, retired on a union pension.

The retired workers were interviewed at the union offices or in their own homes to determine their attitudes toward retirement. The interview schedule included several questions involving a comparison of work performance just prior to retirement with work performance five years before retirement.

The findings indicate that these retired workers recognize that they do slow up physically as they grow older. Sixty-seven per cent of the respondents reported that prior to retirement they were not able to turn out as good a day's work as they had been able to do five years before; 83 per cent reported that they had to work harder to do so; 52 per cent reported that they turned down overtime more than formerly; 51 per cent were worried about not being able to keep up with younger workers; 84 per cent stated that travelling to and from the job tired them more than before. As might be expected, the responses to these questions are statistically interrelated.

The attitudes of older workers toward their work performance may affect their relationship and socialization with younger workers within the plant. For the group studied, this is so. Thirty-seven per cent reported that younger workers tease and annoy older workers, and 60 per cent agreed that younger workers think older workers should retire and give them a chance to earn a living.

A Comparison of the Somatic and Psychosomatic Complaints of Institutionalized and Non-Institutionalized Older People.

J. TUCKMAN, I. LORGE, R. STEINHARDT, *and* F. D. ZEMAN, *Teachers College, Columbia University, and Home for Aged and Infirm Hebrews of New York, New York, New York.*

The Cornell Medical Index and a shorter supplementary questionnaire designed to cover somatic and psychosomatic complaints more applicable to older individuals were given to: 1) an institutionalized group of 171 men and women, 61 to 91 years of age, residing in an old age home and in an apartment house, under institutional auspices; and 2) a non-institutional group of 97 men and women, 55 to 88 years of age, residing in their own homes.

For the institutional group, women report a significantly greater number of physical and psychosomatic symptoms than men; for the non-institutional group, there are no sex differences. The institutional group tends to have fewer symptoms than the non-institutional population. For men, the differences are significant for the somatic and psychosomatic sections on both questionnaires; for women, the differences are significant only for the somatic section of the CMI.

On the CMI, there is a negative correlation between age and the number of somatic symptoms, and between age and the number of psychosomatic symptoms, for men and for women. However, these correlations are significant only for men. On the supplementary questionnaire, the correlation between age and the number of symptoms is slightly negative for men but slightly positive for women. However, none of these correlations are statistically significant. The tendency for the number of symptoms to decrease with age suggests that as individuals grow older, they minimize their complaints because they accept more readily the cultural stereotype that ill health is a concomitant of aging.

Importance of an Observation Period for Suspected Mental Cases in a Detention Unit of a Chronic Disease Hospital, Survey of 126 Cases Sent in for Commitment to a State Mental Institution and Their Final Disposition.

A. J. TUTLES, *Hillside Home and Hospital, Bridgeport, Connecticut.*

The main object of this paper is to prove that many supposedly mental patients are hurriedly transferred from their homes in an atmosphere of extreme excitement and confusion.

The family doctor is called only to discover that the patient is so difficult to handle that confinement and restraint and, inevitably, commitment to a mental hospital seems to be the easiest and quickest solution to the problem. Therefore, the patient is sent up on a thirty day emergency commitment.

This survey reveals that many of these conditions are often caused by over-medication, alcoholic intoxication, hysteria, or nutritional deficiencies.

At Hillside there is a Detention Unit where these patients are observed for a period of three days or more. The results of the survey are startling. There is no doubt that in many instances the original diagnosis of a mental disease was in error. Of the 93 cases under observation for three days or more, only 18 were committable to the mental institution. This is attacking the problem of overcrowding in our mental institutions at the proper point.

If we adopt an observation period we will be aiding the prevention of patients unnecessarily entering mental institutions, thus minimizing the construction of new buildings to house them. The patient will not

experience the shock of suddenly finding himself in an institution only to be released within a few days as normal, possibly leaving fear in his own mind as well as in the minds of his family, friends, and employers that, if at any time he again became emotionally upset, a suspicion might arise that he might well be a mental case.

Many cases at Hillside were found to be due to an emotional hysteria caused by environmental influences. The solution was in advising the patient to avoid the causative factor. Other cases were found to be caused by malnutrition. Many gross psychiatric symptoms were eliminated by nutritional therapy.

There is no doubt that with proper evaluation, classification, rehabilitation, and placement of the chronically ill, infirm, and the aged, we will be able to prevent further mental and physical deterioration of both mind and body and thus enable many of them to lead happy, useful lives far into their old age.

W

Medical Preparation for Retirement.

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A number of factors contribute to the emotional and physical health of annuitants.

The diversity and complexity of the problems of retirement require careful, long-term planning by the employee, the medical department, and the employee relations department if the desired goal is to be reached.

Attempts to compensate for previous inadequacies in the provision or utilization of such programs are worthy of consideration. It is realized that such efforts in behalf of employees facing retirement are sure to meet with limited success.

Degenerative cardiovascular diseases are the cause of most deaths and disabilities among the annuitant group. Limitation of time available for discussion with the prospective annuitants justifies concentration of efforts upon this particular cause of death and disability.

Our present knowledge concerning these diseases warrants providing guidance to the annuitant group concerning nutrition, physical activity, and emotional health.

Blood Volume Estimation in Preoperative Preparation of the Aged.

J. M. WALKER, *University of Pennsylvania, School of Medicine, Philadelphia, Pennsylvania.*

An increasing number of operations are being performed on patients in older age groups. More surgery is being performed for cancer, inherently a disease of later life.

Adequate preoperative preparation is important for all patients, but particularly so for older patients, handicapped by disease and by infirmities associated with advanced age.

Hypoproteinemia and reduced blood volume, consequent upon malnutrition or malignancy, must be corrected to prevent reduced resistance to blood loss and infection, and to assure normal wound healing and fluid balance. Attention to such matters, in conjunction with other aspects of therapy, may well be in part responsible for low mortality, while successful surgical techniques are employed in patients of more advanced age.

Since 1947 blood volume has been estimated in over 1800 patients on the general surgical service at the Hospital of the University of Pennsylvania, principally in cases where extensive surgical procedures were contemplated. Forty per cent of these patients were over age 60, 17 per cent over age 70.

Plasma volume was estimated with Evans blue dye, and blood volume calculated using venous hematocrit readings. Heparinized blood samples were drawn, one prior to injection of 10 mg. of dye, and three at 15 min., 30 min. and 45 min. after injection, permitting plotting of time/concentration curve and extrapolation to "zero-time." Plasma volume estimations varied by 3 per cent, blood volume by 5 per cent, in 20 normal subjects. Estimates were reliable for deviations in volume relative to average normal values.

Blood volume was not reduced with advanced age per se, but with decreased physical activity, and was further reduced by disease if present.

Additional data will be presented correlating blood volume changes with physical activity and in relation to certain disease entities.

Recreational Activities of Older People.

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For older people generally and for retired people in particular, recreational activities play an increasingly important role as more leisure becomes available. Patterns of free-time behavior have important effects on adjustment and are related to age. Perhaps no other factor in the life pattern is more significant than the part played by recreation as the time-filling functions of earlier adulthood—gaining a livelihood, caring for children and home—are gradually sloughed off.

Four field studies were conducted during the summer of 1951 to collect data on the characteristics, social participation, attitudes, and values of older people in Florida. Using schedules developed for

the purpose, random samples of retired people in Orlando and West Palm Beach and of people 60 years of age and over in St. Cloud and Winter Park were interviewed. Information on social adjustments of communities to their aged population was obtained from other sources. In 1952 a state-wide survey brought together data on existing recreational programs for older people in Florida cities.

This paper discusses the kinds and relative importance of free-time activities of the samples. Relationships to age, sex, education, and other factors are analyzed. Patterns of recreational behavior in the communities are compared and related to the organized activities programs maintained or sponsored by the four municipalities. Finally, the nature and scope of recreational programs for older people in the state are described.

A Comparison of Rorschach Findings on Aging Subjects with Their Psychiatric and Social Ratings.

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The purpose was to evaluate the Rorschach findings on a group of aging individuals as a measure of the quality of their social adjustment in a group situation and of their emotional well-being as revealed by a psychiatric examination. The subjects were 20 individuals (12 female and 8 male), between the ages of 55 and 65. All were members of a class on the problems of aging, participating in an extensive study on the psychology of aging.

All subjects were independently ranked by a psychiatrist, psychologist, and sociologist according to the degree of their adjustment. For the Rorschach ratings, global ratings were made on each record, and the records were then ranked from general intactness of the personality structure to pathologic disentegration. For the psychiatric rating, each individual was interviewed and rated from general emotional health with intact defenses to pathologic disturbance. For the social rating, observation of the subject's behavior in the class situation and in subsequent social situations was used as a basis for rating them from constructive, healthy interpersonal relations to antagonistic, unhealthy ones.

There was a high, positive correlation between Rorschach and psychiatric ratings (rho $=$ .84, $P < .01$), and a low, positive correlation between Rorschach and social adjustment ratings (rho $=$ .40, $p > .05$) and between psychiatric and social adjustment ratings (rho $=$ .51, $P < .05$).

The Rorschach test can be used as a measure of the general intactness of the personality structure of aging individuals. However, it is of only limited usefulness in predicting the constructiveness of an individual's behavior in actual social situations. The reasons for this will be discussed in light of personality theory and defense mechanisms.

The Lengthened Life Line.

W. R. WILLIAMSON, *3400 Fairhill Drive, Washington, D. C.*

Adding years to life is the lesser goal of the gerontologists. Strict measurement of the progress toward that goal—at the later ages—has so baffled our American demographers and life-table compilers, that the 1949-1951 United States Life Tables are awaited with tremendous interest.

Mortality rates and life tables have varying idiosyncracies. Those derived from the whole population have shown many errors and biases. Recently additional factors have complicated the earlier situation. The experience of insurance companies shows the results of underwriting selection and of certain revitalizing forces. Life insurance—ordinary, industrial, group—and individual and group annuities are quite individualistic in the development of their apparent mortality rates. Group conversions and so-called permanent total disability incomes show "adverse selections."

The misstatements of age, the incompleteness of enumeration in the census, and the matching of two different sets of data—death reports and census tabulations—all suggest limitations on exactness.

Scientific methods are slow and time-consuming, but the 1949-1951 United States Life Tables offer an excellent opportunity for more comprehensive analysis —and a clearer contrast between facts and appearances. Only after such further study can certain major limitations within the official tables be fully understood and, to some extend, transcended.

At the present time, we do not know the extent of the progress, mortality-wise, over the last twenty years. Since the 1939-1941 United States Life Tables indicated half the population living to about age 70, the untrustworthiness of death rates beyond 70 is annoying in itself and requires recognition in quoting functions like life expectancy and in international comparison.

A Vocational Counselling Program for Older Workers.

P. A. WILSON, *Vocational Guidance Bureau, Cleveland, Ohio.*

The paper deals with the experience of the vocational Guidance Bureau, in Cleveland, Ohio, in the counselling and placement of 500 older workers ranging in age from 45 to 75 years. It covers an experience of two and a half years. Material will include initiation of the experimental project, the difficulties

encountered, types of clients involved, reasons given for unemployment, counselling techniques employed and the adaptation to the older person, adventures in group counselling, attempts to interest industry in pre-retirement counselling, and placement of older men and women in industry, in small business, in retail stores and offices, in service occupations, in outside selling, and in home industry and self-employment. It will also tell of an experiment in the rehabilitation of severely handicapped older persons who were patients in the Chronic Hospital and County Infirmary. Methods employed in getting cooperation of industry on the one hand, and of public and private social agencies, as well as the general public, on the other, will be discussed.

Y

Factors in Hospitalization of 100 Aged Persons.

D. YANACEK, *Hospital Division, Hennepin County Welfare Board, Minneapolis, Minnesota.*

This study was made of 100 hospitalized random cases selected on a basis of the total percentage of admissions to each hospital within the area for the month of November, 1951. There are various tables included showing age distribution, sex, length of hospital care, living arrangements before and after hospitalization, data on diagnoses (from Standard Nomenclature of Diseases) in relation to number of hospital days and placement in nursing homes or other facilities, marital status by age and sex, and previous hospitalizations during preceding year.

It has been a most revealing study and the results will be of assistance in compiling budgets for medical care costs for Welfare Agencies; it also clearly indicates the need for more nursing homes of a specific type for postoperative patients who are not members of a family group to give this type of convalescent care.

The National Old People's Welfare Committee of the United Kingdom

D. RAMSEY

The National Old People's Welfare Committee owes its origin to action taken by the National Council of Social Service in 1940, when a meeting was called of voluntary societies engaged in work for old people. The visits of the Assistance Board officers following the introduction of the supplementary old age pension had revealed that a very large number of old people were living in unsuitable conditions and many of them were in need of care and attention.

At this meeting the voluntary organisations decided to come together and form the National Old People's Welfare Committee adopting the following terms of reference: "To study the needs of old people and to encourage and promote measures for their well-being."

The National Committee has gradually increased its membership and now has representation from all the major national voluntary societies concerned in any way with work for the welfare of old people. Such societies as the Salvation Army, the Church Army, the British Red Cross Society, the St. John Ambulance Brigade, the Women's Voluntary Services, representatives from churches of different denominations, the Royal College of Nursing, and also the local authority organizations, i.e., County Councils Association, Association of Municipal Corporations, the Rural District Councils Association, Urban District Councils Association and also the National Association of Parish Councils. Various associations representing local authority officers, e.g., National Association of Local Government Officers and the associations representing the Directors of Welfare Services and County Welfare Officers, also send representatives. The Ministries of Health and National Insurance and the National Assistance Board are represented in an advisory capacity, and the Ministry of Education is represented on the sub-committee concerned with training.

As a national consultative and co-ordinating body, therefore, the Committee is fully representative of all aspects of social work and statutory provision for old people. Medical aspects are represented by Lord Amulree and Dr. Marjory Warren as individual members and by representation from the British Medical Association.

Each year since 1946 the National Committee has held a conference, which has been recognised by the Ministry of Health and to which representatives come from all over the British Isles, from County and County Borough Councils, and from voluntary organisations. Physicians interested in geriatrics have also attended. These conferences have proved extremely valuable in exchanging information between local authorities and voluntary societies and in coordinating and publicising experiments and work carried out in different parts of the country.

In addition to national activities, the National Committee, with the help of the National Council of Social Service Regional Offices, has established a network of County and Local Old People's Welfare Committees throughout the country, now (April, 1952) numbering 881 (51 County and 830 Local Committees). These committees are represented on the National Committee through regional groups. Regional representation in the case of Wales, Scotland, and Northern Ireland, is by special Old People's Welfare Committees.

These Old People's Welfare Committees are formed on a similar pattern to the National Committee, i.e., they bring together the local branches of the national voluntary societies and the local authorities, local trusts, e.g., almshouses, and individuals, and, where appropriate, advisers from government departments. These local groups study the needs of old people in their area and as a result of cooperation and planning the individual societies represented have gradually increased their work for old people by such services as the provision of clubs, meals services, visiting schemes, and chiropody. Many Old People's Welfare Committees were responsible in the early days for the establishment of a housing society to provide a home for old people and many of them are directly responsible for the provision of various services for the old people in their district.

In January, 1950, Circular 11/50 ("Welfare of Old People," Her Majesty's Stationery Office, London, 1950) was issued to all local authorities by the Ministry of Health. In October, 1949, the Department of Health for Scotland had issued a circular on very similar lines referring to the Scottish Old People's Welfare Committee. These circulars stressed the value of the work of voluntary societies and urged local authorities to do all they could to encourage voluntary workers to undertake more personal services, such as visiting, club work, etc. for old people. The Ministry also recommended the formation of Old People's Welfare Committees on the pattern being promoted by the National Committee as a proved means of valuable cooperation. The result of this circular has been a very rapid increase in the number of Old People's Welfare Committees (numbers referred to previously).

These committees are all serviced by the National

Old People's Welfare Committee by means of a quarterly bulletin and the issue of circulars and leaflets on important matters of national policy. Officers and members of the National Committee travel to all parts of the country to consult with local groups and individuals and to address meetings. Information regarding experiments carried out in different parts of the country is made available to all Old People's Welfare Committees and information is drawn from the Old People's Welfare Committees which help to guide the National Committee in its policy.

In the early days the National Committee concentrated on the promotion of more small homes for those old people who could no longer lead an independent life and an arrangement was made between the Assistance Board and the National Committee, which allowed a special rate of supplementary pension to be paid to an old person who was in need of care and attention and became resident in a home run by a voluntary society. As a result a large number of small homes were started by voluntary societies and by national bodies who had been doing this work for some time. The National Old People's Welfare Committee, together with the National Federation of Housing Societies (one of its constituent members) organised a campaign for the formation of Housing Societies to provide residential homes for old people and this enabled a number of smaller groups to take part in this work.

The National Committee also made representations from time to time to the appropriate Minister on various important matters, such as the removal of the poor law disqualification for the receipt of the old age pension by persons in institutions under local authorities and various anomalies with regard to the payment of pocket money. The Committee also during the war pressed for a special milk allowance for those over 70 and asked for concessions to help old age pensioners pay the increased cost of tobacco and wireless licences. Action was taken to help old people as much as possible about difficulties due to fuel restrictions.

In 1946 a deputation was received by the Minister of Health with regard to the housing provision for old people, the shortage of hospital accommodation, and the need for a wider outlook in the care and rehabilitation of the chronic sick. Some of the recommendations of the National Committee were later endorsed and expanded in the report, "The Care and Treatment of the Elderly and Infirm," published by the British Medical Association in 1947. The Committee also pressed for the registration and inspection of residential homes for old people.

At the time when the National Assistance Act was being discussed the Ministry of Health received suggestions for the amendment of the Act and a number of the suggestions made by the National Committee were adopted. The Act itself incorporated many of the previous suggestions made by the National Committee.

One of the results of the passing of the National Assistance Act is the increase in the number of small homes for old people now being opened up and down the country by local authorities. This, together with the provision previously made by voluntary societies and some local authorities, led the National Committee to consider the question of the recruitment and training of wardens and matrons to take charge of these homes. In September, 1950, therefore, the National Committee, with the financial assistance of the National Corporation for the Care of Old People, inaugurated a series of training courses for men and women who wish to become wardens or matrons of homes for old people. This course had been recommended to the local authorities by the Ministry of Health (Circulars 50/49 and 25/50, "Training Course for Wardens and Matrons of Old People's Homes," Her Majesty's Stationery Office, London, 1949, 1950) and is recognised by the Ministry of Education.

In addition the National Old People's Welfare Committee is now organising short residential refresher courses for matrons and wardens already in charge of small homes. Over 300 superintendents from both local authorities and voluntary societies have attended these short courses.

The National Committee has been much concerned during the last two years over the plight of old people who are too infirm for the ordinary home and who are not able to find beds in hospitals, and the Minister received a deputation from the National Committee on the 17th of May of last year which made various suggestions to help meet this problem. One of the most important points which the Committee believed needed clarification was the question of the maintenance of residents in homes which might be established by voluntary societies to take old people already in hospitals who could not be discharged because they had no relations and there was no suitable home which could receive them. This matter formed the main subject at the Committee's Fifth Annual Conference at which a representative of the Medical Society for the Care of the Elderly, Dr. E. B. Brooke, set out the problem and the difficulties very clearly ("Welfare Problems of Old People," 1950 Conference Report, National Old People's Welfare Committee, London, 1951).

The National Committee has issued two publications which have become widely known throughout the United Kingdom and in America and elsewhere—"Age is Opportunity" (National Old People's Welfare Committee, London, 1949) and "Adding Life to Years" (Lord Amulree, National Old People's Welfare Committee, London, 1951). In addition it has issued Conference reports, information leaflets, and various other publications.

By arrangement with the National Council of Social Service, that Council acts as the National Committee's trustees and a financial statement forms part of the published audited accounts of the National Council of Social Service. The National Committee, through the National Council of Social Service, has received grants from the Ministry of Health during the last three years of £6,000 for 1949-1952. The National Committee has also received a grant of £3,000 for the year 1950 and a similar sum for 1951 and 1952 from the Governors of the National Corporation for the Care of Old People. The rest of the finances are provided by small subscriptions and donations from voluntary sources. The total budget for the year ended 31st of March, 1951, was £16,126.

In 1949 the Ministry of Health issued Circular 51/49 to all local authorities drawing their attention to the possibility of contributing to old people's welfare organisations and pointing out that under Section 31 of the National Assistance Act, local authorities can contribute towards the funds of voluntary organisations whose activities consist in or include the provision of recreation or meals for old people. In addition the Minister pointed out that under Section 136 of the Local Government Act, 1948, contributions not exceeding 50 per cent could be made towards the administrative expenses incurred by such bodies as County Old People's Welfare Committees who are engaged in promoting the formation of local voluntary bodies to further the welfare of old people and in providing such local bodies with a coordinating and advisory service. Apart from this assistance, the work of County and Local Old People's Welfare Committees is carried on by contributions from voluntary sources.

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Gerontology in the United Kingdom
(Addendum)

In the previous review (Journal of Gerontology, 6: 275-287, 1951) the list of the Geriatric Units was given in table 1 (p. 286). Dr. Glyn Hughes has kindly supplied me with an additional list, which is given in the following table. These units, however, cater also for long-stay cases in the younger age groups; most of these are nominated officially as Geriatric Units, some only informally.

Besides this addition, it is necessary to mention some other points.

Dr. Marjory Warren's Geriatric Unit in the West Middlesex Hospital was the first to be established in Great Britain, and therefore Dr. Warren was an initiator in the Geriatric Unit movement in this country.

There was a misunderstanding in table 1 of the previous review in the reference to the Foresthall Hospital in Glasgow; namely, it was stated that Professor S. Alstead is director of Geriatric Research in this hospital. At present, no such appointment exists.

Unfortunately in the previous review my appreciation of the information given was omitted. It gives me great pleasure to do this now, and to express my sincerest gratitude to all the directors of gerontologic research centres and geriatric units, and to the heads and secretaries of the welfare societies, who kindly supplied me with the necessary data. Miss D. Ramsay, Secretary of the National Old People's Welfare Committee, and Miss E. Dunbar, Head of the Public Relations Department of the W.V.S., have prepared special detailed reports on the important activities of their Societies, for which I should like to thank them especially.

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ADDITIONAL LIST OF GERIATRIC UNITS.

Hospitals to Which Units are Attached	Name of Director	Year of Establishment	Number of Patients	Number of Physicians	Research
University College Hospital, St. Pancras Branch, London, N. W. 1	Lord Amulree	1949	150	4	No
St. Francis Hospital, Camberwell	Dr. T. A. M. Johns	1949	334	3	No
St. Alfege's Hospital, Greenwich	Dr. B. A. Young	1951	276	3	No
Brook General Hospital, Woolwich	Dr. E. R. Lewis	1950	48	2	No
Nunnery Fields Hospital, Canterbury	Dr. I. D. K. Stevens	1950	124	2	No
Hill House Hospital, Minster	Dr. I. D. K. Stevens	1950	123	3	No
Linton Hospital, Maidstone	Dr. R. Crosbie Brown	1951	209	2	No
Kent and Sussex Hospital, Tunbridge Wells	Dr. P. T. Cooper	1949	50	1	No
Orpington Hospital, Orpington	Dr. E. A. Scott	1950	290	3	No
Brighton General Hospital, Brighton	Dr. S. J. Firth	1950	116	2	No

BOOK REVIEWS

CELLULAR CHANGES WITH AGE, by Warren Andrew, Charles C. Thomas, Springfield, Illinois, 1952, 66 pages, $2.50.

This book presents a brief review of some of the available literature on alterations within cells. The title is somewhat misleading as the author in his first chapter points out that he is most interested in presenting data on cellular changes associated with senescence—a process of decline. This artificial limitation of the aging process is hardly a welcome one, especially in view of the fact that it both presupposes an ability to determine the initiation of this declining process and also intimates that all cells of the body go through this stage during the life span of the host. There are a number of inconsistencies in approach. The reviewer was unable to determine whether the author was serious in his "senescence limitation" since infant cells were compared with very aged (chronologically) cells and a question as to whether cellular changes were the prime consideration was often to be raised (Chapter 2, page 5 vs. Chapter 2, page 61).

The author has brought together many of the loose ends of information on cellular alterations especially in the higher mammals. His presentation of the changes in nervous tissue in Chapter IV was the best portion of the book.

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COMMUNITY SERVICES FOR OLDER PEOPLE — THE CHICAGO PLAN, prepared by the Committee for the Aged of the Welfare Council of Metropolitan Chicago, Elizabeth Breckenridge, Director, Wilcox & Follett Company, Chicago, 1952, 240 pages, $3.00.

Since the end of the war an increasing number of states and large cities have set up committees or commissions on problems of the aged. The charge to these committees has been for them to inquire into the problems arising from a rapidly expanding population of older men and women and to make recommendations in view of the findings.

The present book is known as "The Chicago Plan." It represents the accumulation of work over a period of four years financed by the Wieboldt Foundation of Chicago. In a very real sense it represents a challenge and a chart for other communities to follow. It is probably the most significant piece of work in its field in defining the areas in which public committees and commissions on the problems presented by older men and women can function and be of value. On the other hand, it is so detailed in its accumulation of facts and in its recommendations as to be almost overwhelming.

The core of the plan upon which the study is based takes into account three groups of older people:

1. Those who are reasonably able in mind and body but who suffer from community prejudices regarding aging.

2. Persons who are less able because of disabilities which have come with age but who through corrective measures may be helped to independent living with some form of special assistance. This group might further be defined as ambulant older people with limited disability.

3. Persons who cannot be restored to independent living but who require services in order that they may live as satisfactorily as possible in view of their disabilities.

The study recognizes that these are not hard and fast classifications and that one group shades into the other.

Throughout the study there is an awareness that any program must be built upon an educational program with the total community as to the special problems and needs of the aged.

According to the study, the community must be brought up-to-date as to the facts involved in the changes taking place in the age composition of the American people. It is assumed that when the facts are known and accepted that this in itself will go far to bring about numerous changes.

The average American community is geared to meet the normal needs and demands of young people and middle-aged people. Older people have been simply forgotten. They have not been thrust aside and no one wished them ill, but there has been a wholly insufficient recognition of their special problems and of the fact that their needs and desires are just as real to them in day to day living as it is to children. Old John may only have two or three more years to live but those two or three more years are just as important to him as the sixty years of expectancy is to the teen-age child. It isn't that the community has been deliberately unkind; it is simply a matter of thoughtlessness and of not being aware that old people need security, a sense of belonging and a desire to be needed just as much as young children or as men and women during their middle years.

The Chicago Plan attempts to bring the needs and demands of old people into proper focus. It accepts the thesis that first in the consciousness of older people is the double problem of employment and retirement. This means that older people, like the rest of us, want to be independent and want to have their place in the sun. In many instances they do not want assistance as much as they want a social situation in which they will be permited to use whatever talents and skills that they possess to be useful to the community and to support themselves.

The way in which the contents of the book are

grouped suggests to local committees interested in the problem how their work may be set up. Roughly, the breakdown is as follows: 1) Employment and retirement, 2) Housing and home services, 3) Health, 4) Recreation and education, 5) Case work and counselling.

Under these five sections are most of the areas in which local and state committees can be helpful. Public committees on the aged are not in a position to make any broad fundamental contributions to the problem. They can, however, as suggested in "The Chicago Plan," make innumerable recommendations and suggestions which they can press upon the community generally and upon the public and private agencies. For example, the need for a pilot plan for adequate home care of certain types of the chronically ill, as against institutional care, can be outlined and pressed upon local health departments.

Employment services may experiment with treating older persons as being handicapped and needing a specialized counselling service. The same with the rehabilitation service. Age is a handicap in many ways and should be treated as such.

A retired executive who still has possibilities of making a useful contribution is quoted as voicing a typical reaction. He said, "I get up in the morning and I think, 'What for?'" The day before he was retired he was supposed to be able to carry many burdens. The next day he is thrust aside as being useless.

One principle established over and over again by the study is the fact that too many people believe that the only possible living arrangement for an older person with special needs is the conventional institutional home for the aged. It is made abundantly clear that, while institutional care is necessary for certain types of individuals needing specialized medical treatment and care, for most older persons living in the community as they have lived before is a far more satisfactory way of life.

The study is extremely definitive and, perhaps, at times too authoritative. Its recommendations cover a wide range of subjects. At times it is overwhelming. It is, however, a pleasure to read, to find how one city has evaluated its problem with older persons, and to have a list of the recommendations to give to older men and women full recognition as citizens.

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YOU AND YOUR AGING PARENTS, by Edith M. Stern with Mabel Ross, A. A. Wyn, Inc., New York, 1952, 212 pages, $2.75.

With approximately 2½ million aged persons now living in the homes of their children the usefulness of a frank discussion of the problems involved is obvious. In "You and Your Aging Parents," the authors have analyzed the problems that arise when grandparents, children, and grandchildren live under the same roof. The problems of living arrangements, financial questions, interference with normal family activities, the relations of grandparents to grandchildren, the physical care of elderly people, remarriage, and many others that arise in the daily living of three-generation families are discussed and specific recommendations are made.

The authors emphasize that the greatest need of the aged is the "need to be needed." Most of the recommended techniques are directed toward fulfilling this basic need. The importance of specific planning prior to alterations in living arrangements is stressed throughout. The book should also do a great deal for children in making explicit the sources of guilt feelings about the care of their aged parents. As the authors state, "blood may be thicker than water," but this fact itself creates many problems. In fact, the three-generation household is not necessarily the best solution of the problem.

The inclusion of many specific anecdotes makes the book most readable. While the stories included often deal with extremes, they serve to illustrate each point and emphasize potential methods of meeting or minimizing the problem. The book is one which could be read with profit by both parents and children. It probably has its greatest potential value if read by children against the time when they will be the grandparents needing care.

The entire book is based on the premise that human behavior is determined by rational factors. Unfortunately this is seldom so, particularly in parent-child relationships which are determined by emotional considerations. As one reads the book one can give intellectual assent to the solutions proposed, but when one turns the question to "Could I do this with respect to my own parents?" — or "Would my parents accept the rational solution proposed," misgivings arise. Perhaps the greatest usefulness of the book would be in the hands of a third party, who would arrange the parent-child conferences and make the proposed recommendations.

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PROCEEDINGS OF THE GOVERNOR'S CONFERENCE ON THE PROBLEMS OF THE AGING. California State Printing Office, Sacramento, California, 1951, 296 pages.

The book is a report of the conference which took place in Sacramento, California, on October 15 and 16, 1951. Two thousand four hundred ninety-seven persons from every county in the state of California participated in the conference. Management, labor,

education, medicine, psychology, economics, and social welfare were represented. It is heartening to note that the elderly themselves were not neglected but were invited to participate at the gathering.

It was indeed a well-planned working conference. No field of gerontology was overlooked. Community organization, education, employment, housing, finances, health, social service, and research were the main divisions into which the conference was grouped. The majority of divisions were in turn sub-divided so that there were, in all, 22 working sections.

Every division presented recommendations. One may find among them enough criticizable material. The overall impression is, however, that the conference did essential gerontologic and geriatric work. It is impossible to discuss all recommendations here. Only a few are cited in order to give an impression of the atmosphere of the conference as it is mirrored in the *Proceedings*.

The section, "Community Programs for Rural and Small Communities," stressed specifically that older persons who are familiar with difficulties faced by the aging population should be included in any community council. Section 2 recommended that a continuing citizens' committee on problems of the aging should be formed in medium-sized cities to stimulate concern and promote community action. Section 4 recommended that a program should be set up designed to restore deteriorated skills and crafts to retired older workers. Section 6 considered that an educational program about retirement can be effective if started before rather than after retirement.

Division C, regarding employment opportunities, recommended a program of education of employers and the public which will demonstrate to them that it is good business to employ elderly people. The section, "Public and Private Housing," found that large "segregated" projects exclusively for elderly should be discouraged and recommended smaller groups for the sake of sociability, better community services, and mutual self-help. The section, "Public Insurance," suggested that OASI be declared the basic public system of retirement and that provision should be made for integrating all other public systems into it. The section, "Public Assistance," recommended that no changes be made in present legislation which prohibits public inspection of old age security laws.

Division K recommended surveys and any other possible form of research. Mental and physical health were discussed and numerous recommendations made. Of special interest is the idea that some type of assessment centers which would facilitate a more rapid turnover of congested hospital beds and permit many elderly persons to return to their homes should be created. It was also believed that the family physician should be the key person in guiding the medical care of the aging population.

The *Proceedings* as a whole is well-edited and the material clearly presented. It contains repetitions, however, which, if avoided, would help a busy gerontologist to use his time more economically. Since the conference covered all major problems of contemporary gerontologic practice, its value extends beyond California's boundaries. The book, which is a painstaking report of the conference, is therefore both a good source of information of the condition of the elderly in California and about practical gerontologic problems in general. It is an encouraging and stimulating book.

The conference chairman was Adrien J. Falk, its executive secretary Louis Kuplan.

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OLD AGE AND RETIREMENT IN RURAL CONNECTICUT: I. EAST HADDAM: A SUMMER RESORT COMMUNITY, 1951, by Walter C. McKain, Jr. and Elmer D. Baldwin, Bulletin 278, Storrs Agricultural Experiment Station, College of Agriculture, University of Connecticut, Storrs, Connecticut, 1951, 46 pages.

This excellent bulletin summarizes and interprets the responses of some 220 older persons of a so-called summer resort community in rural Connecticut to a comprehensive schedule of questions about education, occupation, migration, health, independence, adjustment, leisure, and health.

For the researchers, it must have been a dissappointment indeed that when responses were cross classified for age, sex, education, origin, etc. that very few of the 220 old people were in any subgroup. The reader, too, shares the researchers' frustration since brevity prevents the presentation of the basic data for these very subgroups.

East Haddam's older people, through the authors, refute the stereotypes about the adjustment of persons past their sixty-fifth birthday. They give the "lie" to the very many, not excluding physicians, psychologists, and sociologists, who believe that the older members of the population no longer can care for themselves economically, socially, or physically. East Haddam's older population however can and do. For they report "one-third are either currently employed or have the income of husbands who have current earnings. Another one-third have savings, investments or pensions that constitute their major source of income."

In health, too, East Haddam's older members seem good. About half report that they had "good" health and many state that they have no ailments of any kind. The feeling of "good" health changes with age. While 53 per cent of those aged 65 to 74 years report

"good" health, only 42 per cent of those past 75 years make such a report. It is significant that 53 per cent of the 65 to 74 year olds reported their health the "same" as at age 55 years, but only 40 per cent of those beyond 75 years felt the same as at age 55. The data suggest strongly that those who had knowledge and/or means for health care in the younger years were those who were in better health in the golden years.

Much of the adjustment in the later years depends upon the adjustment during the earlier years. Succinctly say the authors, "The older a person is the more like himself he becomes." The wider the range of things he can do, of experiences he can use, of people he knows, the more of himself the older person can be. It is the depth of experience and the wealth of wisdom that maintain the older person's self concept.

From the data, by implication, comes the suggestion that the greatest obstacle to adequate adjustment of the older person is the acceptance of cultural semantics —the acceptance of wrong notions and stereotypes about aging. Bulletins like this, which is the first of a series on the older person in rural Connecticut, can lead to a genuine reevaluation of self-sufficiency of the elders in the population. Facts, and yet more facts, can lead to a real appraisal of the aging population.

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BOOKS RECEIVED

Books received since April 1, 1952, are acknowledged in the following list. In so far as space and time permit, some will be selected for review in a later issue, but it is unlikely that all will be reviewed.

Cellular Changes with Age, by Warren Andrew, Charles C Thomas, Publisher, Springfield, Illinois, 1952, 66 pages, $2.50 (reviewed in this issue, page 505).

Clinical Use of Fluid and Electrolyte, by John H. Bland, W. B. Saunders Company, Philadelphia, 1952, 259 pages with 75 figures, $6.50..

Community Services for Older People — The Chicago Plan, prepared by the Committee for the Aged of the Welfare Council of Metropolitan Chicago, Wilcox & Follett Company, Chicago, 1952, 240 pages, $3.00 (reviewed in this issue, page 505).

Cowdry's Problems of Ageing, 3rd edition, edited by A. I. Lansing, The Williams & Wilkins Co., Baltimore, 1952, 1052 pages, $15.00.

Current Therapy 1952, edited by Howard F. Conn, W. B. Saunders Company, Philadelphia, 1952, 849 pages, $11.00.

Florida's Older Population, by T. Stanton Dietrich, Retirement Research Division, Florida State Improvement Commission, Tallahassee, 1952, 42 pages, mimeographed, paper bound.

Guide for Community Planning for Older Age, by Philip W. Swartz, Community Council, 211 State Street, Bridgeport 3, Connecticut, 1952, 30 pages, mimeographed, bound with flexible hard covers, 60¢.

Histology, Histopathology, and Function of the Senile Ovary, by Hannes Sauramo, Annales Chirurgiae et Gynaecologiae Fenniae, volume 41, 1952, supplement, 66 pages.

How to Help an Alcoholic, by Clifford J. Earle, the Westminster Press, Philadelphia, 1952, 96 pages, $1.50.

New Horizons for the Aged, papers presented at the 20th Annual General Assembly, (1951) Council of Jewish Federations and Welfare Funds, 165 West 46 Street, New York 36, New York, 1952, 15 pages, mimeographed.

Prescription for Medical Writing — a Useful Guide to Principles and Practice of Effective Scientific Writing and Illustration, by Edwin P. Jordan, W. B. Saunders Company, Philadelphia, 1952, 112 pages with 26 figures, $2.50.

Proceedings of the Governor's Conference on the Problems of the Aging, Sacramento, California, 1951, 616 K Street, Sacramento 14, California, 1952, 296 pages, paper bound (reviewed in this issue, page 506).

Rheumatic Diseases, prepared by the Committee on Publications of the American Rheumatism Association, W. B. Saunders Company, Philadelphia, 1952, 449 pages with 126 figures, $12.00

Steps Toward Prevention of Chronic Disease, Summary of a Conference, Health Publications Institute, Inc., Raleigh, North Carolina, 1952, 27 pages, paper bound, 50¢.

Survey Report. A Study of the Jewish Aged and Chronically Ill of Cincinnati, conducted under the auspices of the Bureau for the Care of the Aged and Chronically Ill of the Federation of Jewish Agencies of Cincinnati, 1430 Central Parkway, Cincinnati, Ohio, 1952, 44 pages and 55 charts, mimeographed.

Textbook of Pharmacology, by William T. Salter, W. B. Saunders Company, Philadelphia, 1240 pages with 284 figures, $15.00.

The Time of Your Life, by James E. Graham, George Weston Limited, 133 Peter Street, Toronto, Canada, 1952, 45 pages, paper bound.

You and Your Aging Parents, by Edith M. Stern and Mabel Ross, A. A. Wyn, Inc., New York, 212 pages, $2.75 (reviewed in this issue, page 506).

INDEX TO CURRENT PERIODICAL LITERATURE

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The subject categories are those in *A Classified Bibliography of Gerontology and Geriatrics* by Nathan W. Shock published by Stanford University Press, Stanford, California (1951). Only major headings are used and the Roman numerals correspond to those given in the bibliography. In so far as possible, references are classified according to organ systems. Thus most of the material on Geriatrics will be found under the organ system involved in the disease. Cross references are indicated by number at the end of each section. When available, abstract references are given *(B.A.—Biological Abstracts; P.A.—Psychological Abstracts;* and *P.I.—Population Index).* Abbreviations for journals are those used in *A World List of Scientific Periodicals Published in the years 1900-1933,* 2nd Edition. For journals not listed, abbreviations were devised according to the general rules used in the above source. It is impossible to cover all journals and list all papers concerned with aging and the aged. Authors and publishers are requested to call attention to publications or to send reprints to the Gerontology Section, Baltimore City Hospitals, Baltimore, Maryland. The assistance of the Forest Park Foundation, Peoria, Illinois, in the preparation of these materials is gratefully acknowledged.

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BIOLOGY OF AGING

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